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The Lure of the Lake Superior Copper Country

Mines, Mining and Miners and a Great Mining School—Air the Life Blood of an Industry Abounding in Thrills and Romance

By FRANCIS JUDSON TIETSORT

THE EYE of the intellect "sees in all objects what it brought with it the means of seeing," quoted Carlyle in his essays. For one to have been born and reared in a land of copper, to have had youthful imagination fired by tales of the riches of a Calumet & Hecla, to have fostered hopes of adventuring some day down a shaft extending a mile or more into the bowels of the earth, is to be on the *qui vive* with expectation when one's opportunity comes, say twenty-five years later.

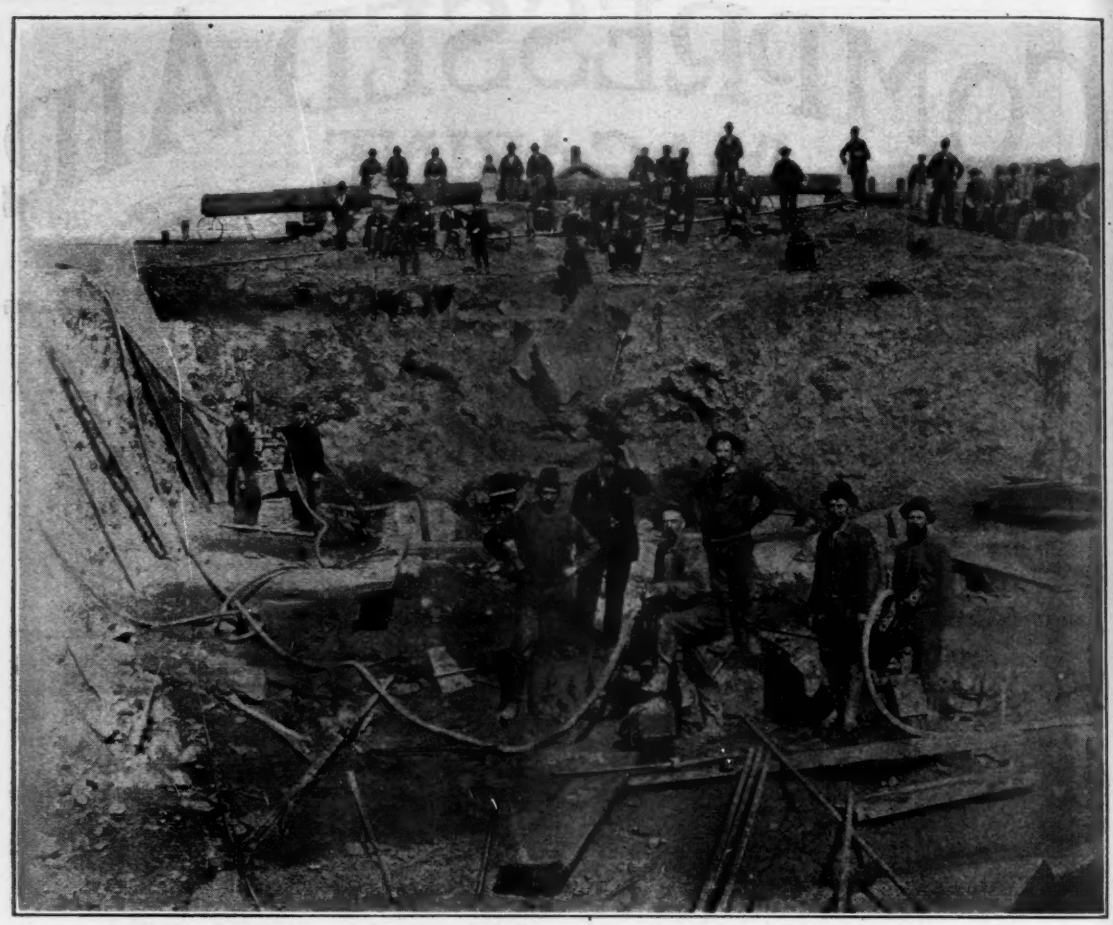
Once in a while a rustic from his bucolic bowers comes to New York and tingles his vertebra for the first time by a ride in the express elevator of a skyscraper and then goes home to the crackerbox of the hamlet's general store to tell an audience all agape about his experience. If one has not ridden in an open skip down the inclined rockbound shaft of a great copper mine at the rate of 2,000 to 3,000 feet a minute, the route ahead into the murky depths lighted only by the miner's carbide lamp thrust into his cap, he may be pardoned for his merriment over the ruralite from Toonerville, but he will have a fellow feeling with the latter if he has made the mine trip by skip. Our very own excursion this summer down Osceola Shaft No. 15 of the Calumet & Hecla in Northern Michigan, will always stick out in memory as the big feature of our sojourn there, but of that incident, more later.

Midsummer found the writer in the Copper Country of the Upper Peninsula, clad in the longer balbriggans of autumn commerce, and overcoat, gloves and straw hat, the latter appurtenance of apparel seeming almost out of place. The invigorating clear air of always cold, deep and mysterious Lake Superior, the lake that never gives up its dead, that is shot with the Northern Lights, was blowing across Houghton and Hancock. Four to five hundred miles south and a thousand miles eastward the country was sweltering under a "heat wave." Up there, in a clime where there are two seasons, winter and summer, the former occupying more than two-thirds of the year, one found a head of steam in the radiators of the offices and surface buildings of the mining companies, and felt grateful for its warmth in the early morning hours.

To see something of the Copper Country was the avowed intent of our visit; to learn how practical copper mining men wrest the ore from the earth and convert it to the metal of commerce; to note how these men live and have their being; to observe the character of the land of their labors. We came away with something of a feeling that copper should be regarded as a precious metal, in peace or war, regardless of its market price; that it was fitting it should be recognized in every monetary system; that it was appropriate it should conduct the electrically flashed tidings of a world.

To describe copper mining would be to attempt to summarize processes pertaining to a highly systematized industry that has engaged the best efforts of great engineers for centuries past, and this has no part in our present purpose.

The Michigan Copper Range, since the discovery and development of the vast copper deposits of the Far West, has taken a secondary position in American production, the output being about



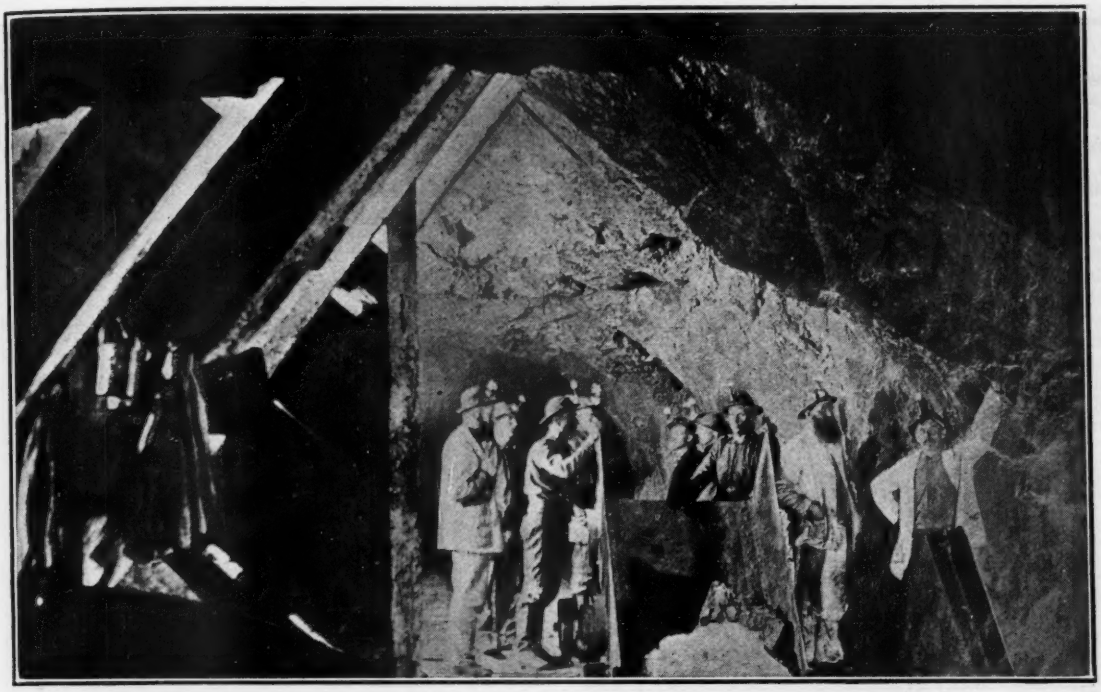
THIS IS AN HISTORIC PICTURE OF THE BEGINNING OF WORK ON SHAFT NO. 15 OF THE OSCEOLA (AMYGDALOID) LODE OF THE CALUMET & HECLA MINING CO., NEAR CALUMET, MICH. IT WAS DOWN THIS SHAFT THAT THE WRITER DESCENDED TO A DEPTH OF 2,700 FEET. THE FIGURE IN THE CENTER STANDING, WITH HIS HAND TO HIS HAT, IS THAT OF THE THEN MINE CAPTAIN, "JIM" HOATSON, A FAMOUS CHARACTER IN THE MICHIGAN COPPER COUNTRY, WHO HAS BECOME A MULTIMILLIONAIRE IN LESS THAN TWO DECADES.

ten per cent, of the total produced in the United States. But from the business side, these fine Upper Michigan properties continue to hold great potentialities for the development of wealth. There is now a renewal of expectation of increased production; in fact, the movement has already begun and miners are in demand on the Copper Range.

The American copper industry dominates the world's supply. After the armistice was signed production fell off from about one-third to one-half, because America and the Allies found themselves overstocked. The industry has now successfully passed the most trying phase of the reconstruction crisis. This has only been accomplished by the close coöperation of the operators. The surplus of red metal in this country, which in early summer amounted to twelve hundred million pounds, has been rapidly dwindling, but at this writing has not been wiped out by either contract or consumption. Nevertheless copper has been mounting in price and halcyon days again appear to buoy up both market and industry.

Depression was being followed by hopefulness when the writer was in Houghton. Copper had risen from the low of 14½ of early spring to 18½ cents in July. Some of the more optimistic thought there was a chance then for twenty-cent copper. There was a quiet tip abroad for everybody to buy good copper stocks. At the time we write, at the end of August, the best copper, which means Lake Superior copper, is at 23½ cents.

Optimism has been reflected most of the year by the porphyry companies of the west, in that



HERE IS AN UNDERGROUND SCENE OF MANY YEARS AGO IN THE CALUMET & HECLA. NOTE THE OLD-TIME LAMPS—TO SAY NOTHING OF THE WHISKERS.

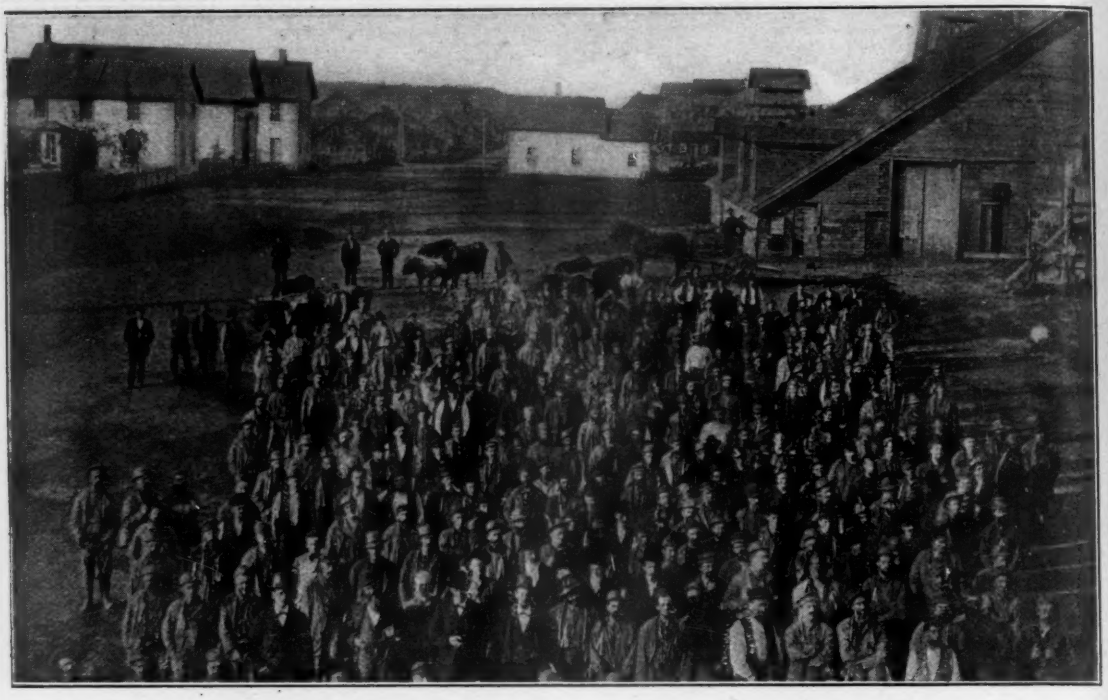
there has been no change in their dividend rate. Take the twenty leading copper stocks as an average and they were selling in midsummer at only one-half a point below the prices of the date of the armistice. In fact Mr. John D. Ryan, head of the Anaconda group, took occasion to raise his voice against carrying prices too high. Sales have been exceeding what was the monthly production of 115,000,000 pounds, for the entire country, but this was only about two-thirds of the copper production rate of 1917 and 1918. The general business expansion means increased movement of copper this year and then, too, export orders are on the way. Those who have been hanging on their copper shares and taking on more are winning out. And everybody in the Northern Michigan Copper Country dabbles in copper stocks—it's as natural with folk there as shooting African golf is in Baltimore.

While on this phase of the subject it might be well to note in passing that the example of the Copper Export Association is being followed by a silver export association, members of which are determined to break the grip of the four London brokers who have so long controlled the price of the white metal. This new silver combination is being formed under the provisions of the Webb law. Some of the copper producers of Michigan and the west are also silver producers.

Lake Superior copper is worth a cent or more a pound in excess of other copper because of its greater ductility, which is a result of its peculiar molecular construction. The sulphide copper of the west, which incidentally goes through the same electrolytic process, shows a different chemical result when reduced to ingots. So all copper is not "just copper." It differs. Michigan copper is better for the electrical trades, for sheathing ships, for roofs and many particular requirements. An added advantage in the mining of Michigan copper is that the lodes run true to calculations—with almost mathematical exactness.

The Michigan mines, along with those of Montana, Arizona and Alaska, comprising the world's richest producers, are enabled now, with copper at from 23 to 24 cents, to make a handsome profit, even with production at little more than fifty per cent. capacity. The copper industry, of course, has largely been assisted by governmental action in carrying the copper surplus, but in coming months foreign and domestic demand is expected to wipe out this surplus, and a stabilized industry will then stand on its own foundation without having been subjected to dangerous losses. As copper is one of the prime essentials in the world's affairs, critics of governmental assistance have been answered with the retort that it was as fitting to protect copper as it was to stabilize wheat for the farmers.

Copper mining began actively in Northern



ANOTHER OLD PICTURE TAKEN IN THE SEVENTIES SHOWING A GROUP OF MINERS AT THE CALUMET & HECLA. NOTE THE OLD WOODEN SHAFT HOUSES (NOW SUPPLANTED BY STEEL) AND THE YOKED OXEN, IN THE BACKGROUND.

Michigan about the same time as iron mining, in the early forties, and the writer encountered a few very old-timers who were able to recall those days. The existence of both copper and iron in the region, however, had been well known to white pioneers and explorers since shortly after the opening of the eighteenth century. There is evidence that the aboriginal Indians took out copper, using it for utensils and weapons, and that they even succeeded in tempering it to a degree.

There are more than a score of large producing copper mines in Keweenaw Peninsula and its vicinity, among them the original and world-famous Calumet & Hecla, which was long known as the most profitable copper mine in the world. Up to a decade ago it had earned dividends of $107,850,000 and since that time $2,900,000 in 1910; $2,400,000 in 1911, $4,200,000 in 1912, $3,200,000 in 1913, $1,000,000 in 1914, $5,000,000 in 1915, $7,500,000 in 1916, and $8,500,000 in 1917. The total to Dec. 20, 1917, was $145,250,000, or $1,450.25 per share, being the largest dividends ever paid by any incorporated mining company, and in addition, the Hecla Mining Co., and the Calumet Mining Co., before their amalgamation under the present title paid dividends aggregating $950,000. Dividends received from other mining companies amounted to $2,226,930 in 1916. During 1917, C. & H. paid three dividends of $25 per share and one of $10, the last being reduced to conserve cash resources for heavy Federal taxes, estimated at between $2,000,000 and $3,000,000 for 1917.

According to Walter Harvey Weed's *Mines Handbook,* 1918, since the change in charter, 1905, permitting the acquisition of stock in other corporations, the Calumet & Hecla has procured control of various other mines and mineral tracts, by organizing subsidiary corporations, and also by acquiring stock in companies previously organized. In 1905 the company bought the following stocks, at a cost of $8,592,129.99 in cash and notes; 9,600 shares of Osceola; 19,400 shares of Tamarack; 24,796 shares of Ahmeek; 27,507 shares of Isle Royale; 10,316 shares of Seneca; 25,000 shares of Laurium. The effort to obtain actual control of the Osceola Consolidated Mining Co., at the annual meeting of March, 1917, was met by opposition which took the contest into the Michigan Legislature and the Federal courts. After nearly two years of strenuous litigation, the Calumet & Hecla obtained control of the Osceola and other Superior Mining companies formerly under the management of A. S. Bigelow by means of an agreement with Mr. Bigelow, by which his entire stock interest was disposed of to the Calumet & Hecla. From the

A VIEW OF THE MAIN STREET OF HOUGHTON, MICH., SHELDEN ST., SHOWING IN THE LEFT FOREGROUND A PORTION OF THE HANDSOME HOUGHTON CLUB. HERE FOREGATHERS THE FAMOUS "ROCK HOUSE GANG," AS IT IS FACETIOUSLY CALLED, NUMBERING MEN OF LARGE AFFAIRS IN THE "CAPITAL" OF THE MINING COUNTRY. BEYOND THE CLUB IS THE PRINCIPAL HOTEL OF A TOWN WHICH IS CALLED "THE BIGGEST LITTLE CITY IN THE UNITED STATES."

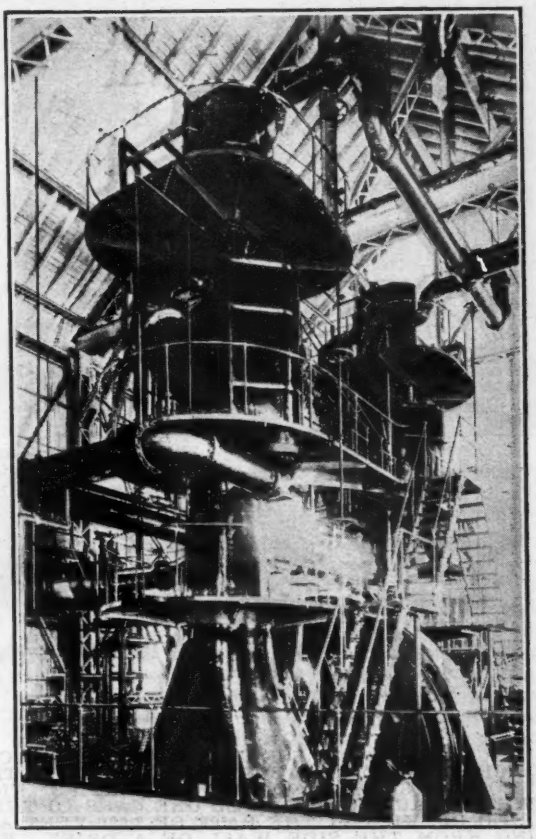
same *Handbook* we have abstracted the physical facts about the properties that follow:

In 1916, Calumet & Hecla offered to purchase the remaining shares of Tamarack Mining Co.; but owing to differences regarding price the matter was not consummated until June 25, 1917, when the C. & H. Company agreed with Tamarack shareholders and the former acquired the assets of the latter. The Tamarack mine now belongs to the C. & H. Co.

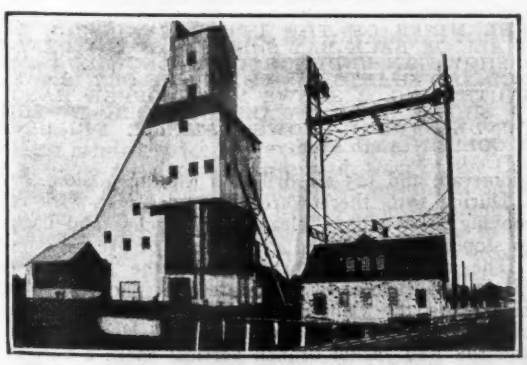
The share holdings of the Calumet & Hecla in subsidiary companies were as follows as of date, December 31, 1916: 41,000 shares of Allouez Mining Co.; 41,500 shares of Centennial Copper Mining Co.; 19,400 shares of Cliff Mining Co.; 50,100 shares of Gratiot Mining Co.; 152,977 shares of La Salle Copper Co.; 32,750 shares of Osceola Consolidated Mining Co.; 50,100 shares of Superior Copper Co.; 39,288 shares of Laurium Mining Co.; 32,910 shares of Isle Royale Copper Co.; 98,048 shares of Ahmeek Mining Co.; 19,400 shares of Tamarack Mining Co.; 34,259 preferred shares and 42,602 common shares of White Pine Copper Co.; 3,482 shares Calumet Transportation Co.; and 2,000 shares in Great Lake Transportation Corporation. The Frontenac, Manitou, Dana and St. Louis companies have been completely absorbed.

On December 23, 1916, the company sold its 11,207 shares of Seneca Mining Co. for $60 per share, a total of $672,420. The C. & H. has no further interest in the Seneca.

The landed holdings of the Calumet & Hecla, including the property owned outright, property controlled through subsidiary corporations, mining lands under options, and timber and miscellaneous lands, in Houghton, Keweenaw and Ontonagon counties, Michigan, amounts to approximately 209,051 acres, of which 102,804 acres are in Keweenaw county. The company, with its subsidiaries, has a waterfront of more than 34 miles, on Lake Superior, Lac La Bele and Torch Lake, and approximately 60,000 people are supported by the operations of the company and its allied interests.

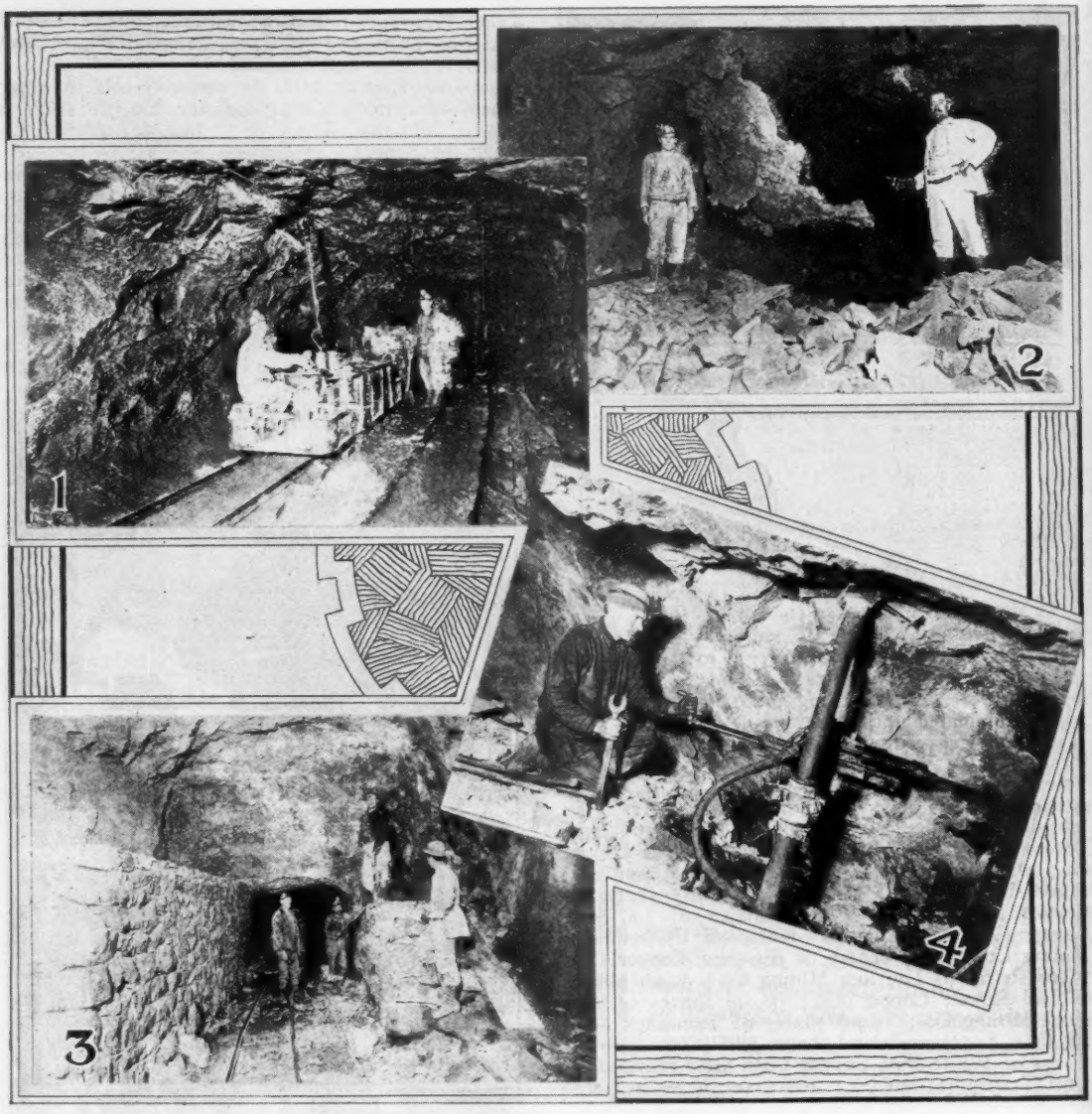


JUMBO HOIST OF THE CALUMET & HECLA. THIS MIGHTY PIECE OF MACHINERY OPERATES SKIPS UP AND DOWN SHAFTS FOR THOUSANDS OF FEET AT GREAT SPEED. RIDING ON THESE SKIPS AND GOING UNDERGROUND, A PRIVILEGE FEW OUTSIDERS GET, GIVES A THRILL TO THE UNINITIATED VISITOR. PASSES ARE ISSUED ONLY BY THE PRESIDENT OF THE COMPANY IN WRITING.



A MODERN SHAFT HOUSE OF QUINCY MINE NO. 2, HANCOCK, MICH., CONSTRUCTED OF STEEL, MASONRY AND CONCRETE.

The original Calumet & Hecla mine, which the writer visited among others, is opened on the Calumet conglomerate bed, and a parallel mine has been developed on the Osceola amygdaloid lode, while



UNDERGROUND SCENES IN THE GREAT COPPER MINES OF THE UPPER PENINSULA OF MICHIGAN. IT IS A BOSTON PLEASANTRY THAT ALL OF BACK BAY SUBSISTS ON DIVIDENDS FROM THESE OLD AND RICH PROPERTIES. FIG. 1 SHOWS AN UNDERGROUND ELECTRIC TRAM WHICH HAULS OUT LOADED ORE CARS TO THE INCLINED SHAFTS, UP WHICH THE ORE IS CARRIED IN SKIPS AT THE RATE OF 2,000 FEET A MINUTE. FIG. 2 SHOWS MASS COPPER HANGING FROM THE SIDE WALL OF A DRIFT. FIG. 3 SHOWS A DRY WALL OF ROCK IN THE TWELFTH LEVEL OF A MINE (1,200 FT. UNDERGROUND). FIG. 4 SHOWS A MINER DRILLING WITH A NO. 18 LEYNER-INGERSOLL MOUNTED ON COLUMN AND ARM.

a third parallel mine has been partly developed on the Kearsarge amygdaloid.

The conglomerate mine, which, until a few years ago, was the entire Calumet & Hecla, has a future life, at the present rate of production, of at least eight to twelve years, it is estimated, followed by five to ten years of scramming, with decreased output. The conglomerate has decreased in average copper contents with depth, but output averaged in 1915, 3.36 lb., and 1916, 3.59 lb. more than in 1914, partly because old pillars, etc., were worked out. The mine works normally 175 power air drills on the conglomerate and 125 air drills on the amygdaloid.

During 1916, there were 78 air drills at work removing shaft-pillars, cleaning up arches and backs of stopes. This yielded 476,310 tons of ore.

The conglomerate property of the Calumet & Hecla is worked as two separate mines, known as the Hecla and the Calumet branches, the south Hecla being a southerly continuation of the Hecla branch, and the Red Jacket branch vertical share a part of the Calumet mine. The Calumet to the north, the Hecla in the center, and the South Hecla at the south from one continuous mine, developing the Cal-

HOW DRILLING FOR BLASTS TO REMOVE ORE IS DONE UNDERGROUND IN THE GREAT COPPER MINES OF NORTHERN MICHIGAN. THIS VIEW SHOWS MINERS OPERATING A NO. 148 LEYNER-INGERSOLL DRILL MOUNTED ON A TRIPOD. Photo Courtesy Ingersoll-Rand Co.

umet conglomerate by incline shafts, the Red Jacket shaft opening the same bed vertically.

The conglomerate opened for two miles along the outcrop, has eleven shafts, eight being known as single compartments, which means a single hoisting compartment with two shafts having two hoisting compartments and one vertical shaft having six compartments. The blind shaft has an electric hoist and the mine has electric station pumps for forcing water to surface with steam pumps acutated by compressed air for short lifts, but it is planned replacing these latter by electric pumps also.

The amygdaloid mine of the Calumet & Hecla is opened on the Osceola amygdaloid bed, which outcrops 730 feet east of the Calumet conglomerate, with parallel strike and average dip of about 38 degrees, underlying the entire main tract of the Calumet & Hecla mine. There are six shafts in the amygdaloid mine, Nos. 13 to 18 inclusive, numbered from south to north. Shafts are duplicate in size, each having three compartments, of which two are used for hoisting and one for pipes and ladder-ways. The amygdaloid has over 35 miles of workings and has frequent connections with the conglomerate by crosscuts. The amygdaloid was closed 1901, and reopened 1904. In this mine the Osceola bed runs about 35′ in width, with principal values along the foot and hanging, the middle third being lean, as a rule.

Laterals in the Osceola workings are carried as drift stopes of 12′ height along the hanging wall. The Calumet & Hecla owns on its main tract, about 11,000 feet of the strike of the Osceola bed. Developed ore reserves of the amygdaloid mine were estimated January, 1916, at 6,000,000 tons, and the Osceola bed has been found to carry fair copper values, at a vertical depth of one mile in the Tamarack property.

As the mills stand on the flat western shore of Torch Lake, but little above water level, tailings speedily fill the shallow lake for some distance off shore, and to deposit the sand it became necessary to attain a considerable initial elevation, which is gained by sand wheels. The material entering the mills as conglomerate rock leaves as coarse sand to the extent of fully 6,000 tons daily. The sludge is washed through launders to the sand houses, where it is scooped up by the buckets of the wheels and dumped, high above into launders running on trestles far out into the lake, these spouting forth miniature brick-red Niagaras. There are two wheel houses, one for each mill.

The Calumet wheel house has sand wheels of 50′ diameter, and the Hecla 50′ and 64′ diameter. The

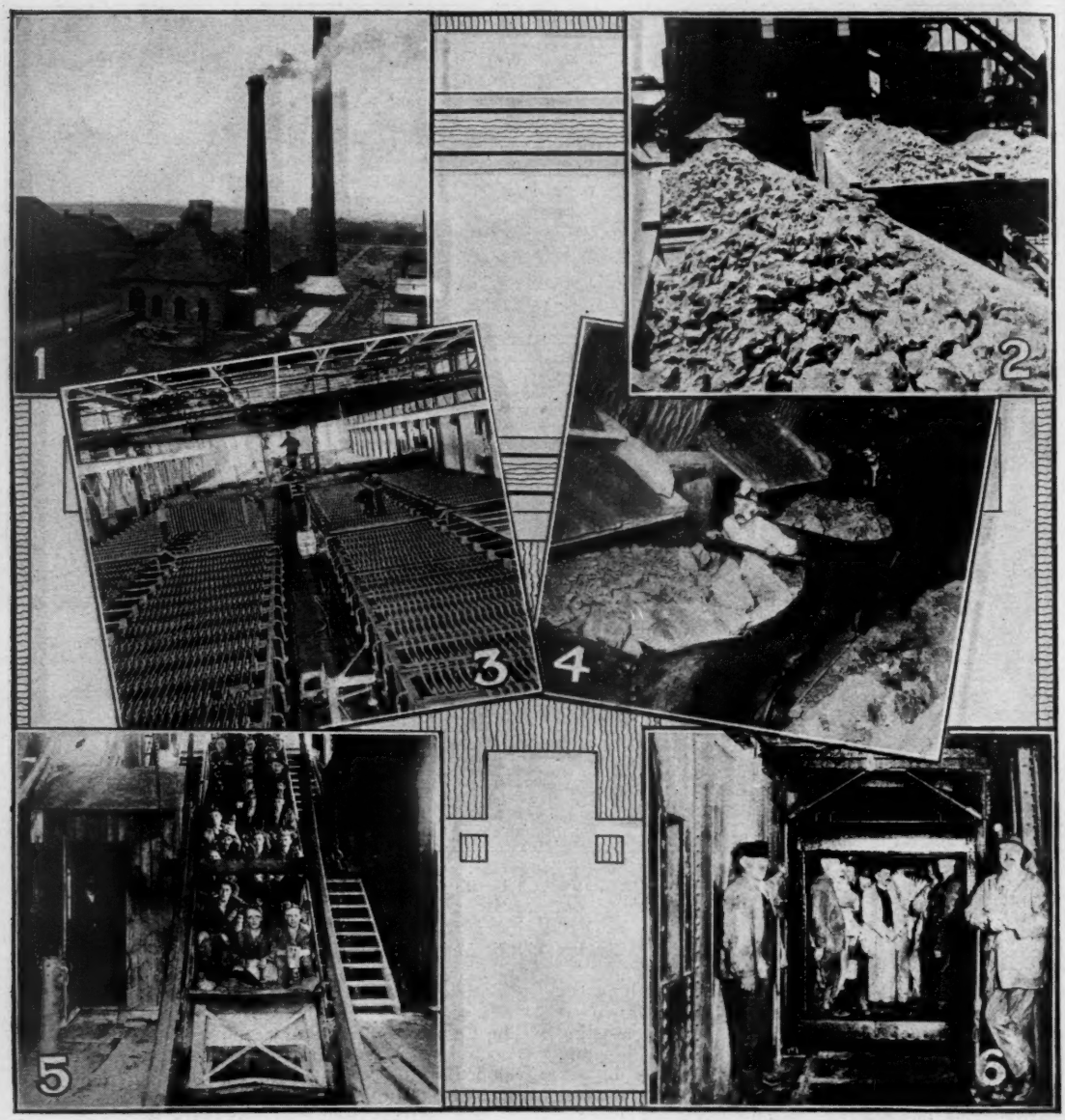


FIG. 1 SHOWS NORTH SUPERIOR BOILER HOUSE AND SHAFTS ON THE CONGLOMERATE LODE, CALUMET & HECLA MINES, CALUMET, MICH. FIG. 2—LOADING CARS WITH CRUSHED ROCK TO BE SHIPPED TO MILLS. FIG. 3—SEPARATING PURE COPPER BY MEANS OF ELECTRICITY. FIG. 4—AT ONE MILE UNDERGROUND LOADING AND HANDLING CARS WITH COPPER ORE. FIG. 5—SKIP FILLED WITH MINERS GOING TO WORK, 5,000 FEET BELOW SURFACE, DOWN INCLINED SHAFT. FIG. 6—MINERS DESCENDING 6,000 FEET IN RED JACKET SHAFT, LONG KNOWN AS THE DEEPEST VERTICAL SHAFT IN THE WORLD.

sand wheel is to all appearances a gigantic bicycle wheel, fitted with spur gearings where the rubber tires should be. The complete wheel weighs 500 tons, and is mounted upon massive concrete masonary. Four 25-ton iron bedplates support the pillars carrying the 21-ton Krupp forged steel axle, which is 27′ long and 32″ in diameter with a hollow core of 26″ diameter. Radiating from axle to rim are 2″ steel spokes 32′ long. The completed wheel is 10′ wide and 64′ in diameter, driven by gear and pinion, power being furnished by a 700 horse power dynamo, and has a capacity of 55,000 gallons per revolution. Nearly two years' time was required to build and adjust this monstrous wheel.

Water for the mills is supplied by four pumps, of which the "Michigan" is the most powerful in the world, having a daily capacity of 60,000,000 gallons. Auxiliary pumps are the "Huron" and "Ontario" of 20,000,000 gallons capacity each, the "Erie" of 10,000,000 gallons and an IP Morris pump of 32,000,000 gallons daily capacity.

The electrification of the Calumet & Hecla was

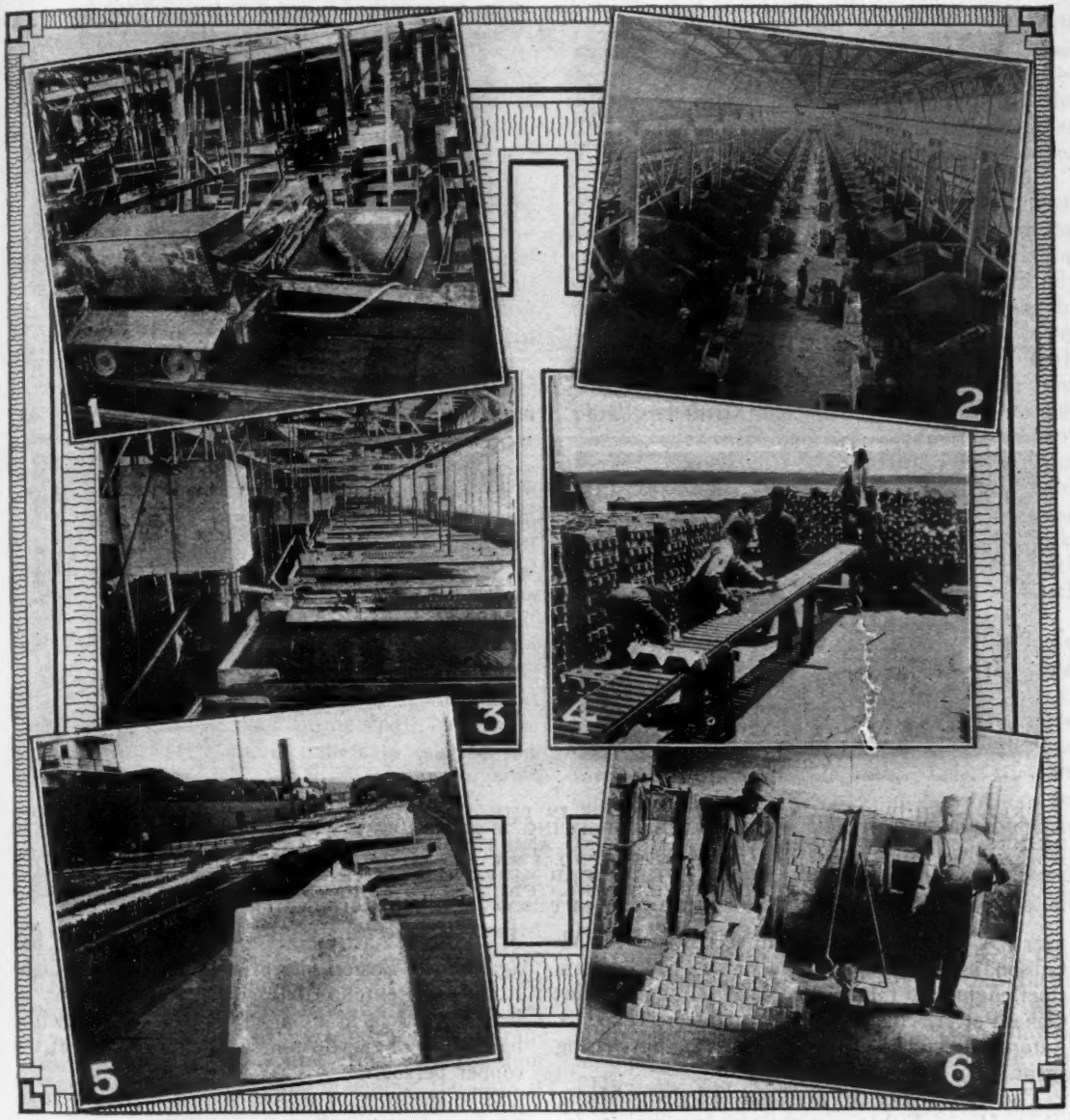


FIG. 1—CALUMET & HECLA MILLS AT LAKE LINDEN, MICH., SHOWING JIGS, SCREENS AND TABLES. FIG. 2—PEBBLE MILLS OF PLANT FOR REGRINDING COARSE SAND. FIG. 3—WIFLEY TABLES IN REGRINDING PLANT SHOWING DISTRIBUTING BOX AND PIPES. FIG. 4—THE UNLOADING OF COPPER INGOTS ON PIER, LAKE LINDEN, MICH., FROM FREIGHT CARS. FIG. 5—LOADING 1,400 TONS OF COPPER INGOTS ON BOARD A GREAT LAKES STEAMER. FIG. 6—SILVER SOMETIMES OCCURS IN COPPER ROCK. THIS VIEW SHOWS A WORKMAN POURING SILVER BULLION, THERE BEING 55 BARS IN THE PICTURE, WORTH MORE THAN $50,000. THIS SILVER WAS RECLAIMED IN ONE MONTH.

begun in 1904 and eventually will be completed, at mines, mills and smelters, except for some of the big compound hoists and air compressors at the mines, where a change from steam to electricity would be a doubtful economy as well as necessitating enormous initial outlays.

Subsidiaries of the Calumet & Hecla Mining Co. are these companies: Ahmeek, Allouez, Centennial, Cliff, Gratiot, Isle Royale, La Salle, Lake Superior Smelter, Laurium, Osceola, Superior, Tamarack and White Pine Copper Co. The Calumet & Hecla officers and operating heads are:

Rodolphe L. Agassiz, president; James Mac Naughton, vice-president and general manager; Francis L. Higgison, Robert F. Herrick and W. Hunnewell, directors; John F. Perkins, secretary-treasurer; Charles A. Hall, assistant treas-

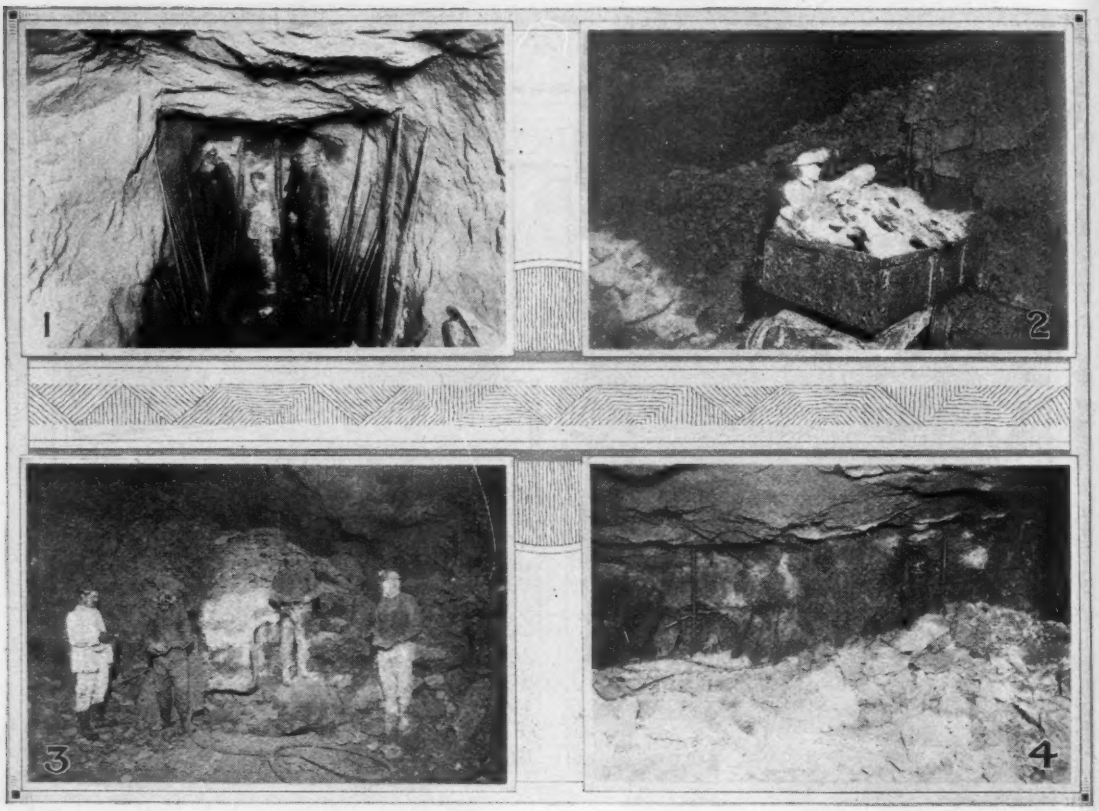


FIG. 1—SHOWS AN UNDERGROUND VIEW IN THE TRIMOUNTAIN MINING COMPANY'S PROPERTY AT TRIMOUNTAIN, MICH., WHERE DRIFTING IS BEING DONE WITH TWO NO. 18 LEYNER MACHINES. FIG. 2—ILLUSTRATING A MUCKING AND TRAMMING JACKHAMER IN USE FOR BLOCKHOLING OR BREAKING BOULDERS IN THE NO. 4 SHAFT, 11TH LEVEL OF THE CHAMPION COPPER CO. AT PAINESDALE, MICH. FIG. 3—NEAR VIEW OF A JACKHAMER IN THE CHAMPION MINE BREAKING BOULDERS ON THE FIFTH LEVEL. FIG. 4—TWO MOUNTED JACKHAMERS ENGAGED IN STOPING ON THE THIRD LEVEL OF SHAFT NO. 4, CHAMPION MINE.

urer; A. J. Garceau, assistant secretary; W. M. Gibson, assistant superintendent; E. S. Grierson, chief engineer; John Knox, chief mining captain; Ocha Potter, chief efficiency engineer; Fred S. Eaton, chief clerk; E. D. Johnson, purchasing agent.

The mill office is at Lake Linden, Mich., where Henry Fisher is superintendent and C. H. Benedict is mill metallurgist. At the smelter office at Hubbell, Mich., H. D. Conant is superintendent.

The Calumet & Hecla Mining Company, which has we have noted, eventually came to control a considerable group of profitable mines, among them the richest producers in the Keweenaw area, has had a career as a corporation matched by few if any other mining corporations in the world. The control of the company long lay among old Boston families, and it is a pleasantry at The Hub that all Back Bay subsists on its C. & H. dividends. The beauty and chivalry of C. & H. aristocracy has been a happy foil against the Boston background for the less highly esteemed elite created by the sacred codfish; at least such is held as a self-evident truth by the haughtiest of the Bostonese *haut ton,* those of the copper persuasion.

The quantity of copper mined increased from 12 long tons in 1845 to 102,543 in 1906, and during the four decades from 1847 to 1887, Michigan's copper product exceeded that of any other state in the Union. In fact, from 1847 to 1883, its production exceeded one-half of all the states, but after 1887, excepting the year 1891, more copper was mined in Montana than in Michigan, and in 1906 and 1907, the yield of both Arizona and Montana exceeded that of Michigan.

To get the copper out to market and to facilitate transportation to and from Houghton and Hancock, it was found advisable to connect long and narrow Lake Portage with its mighty neigh-

bor, Lake Superior, and this was done by a canal dug by coöperation between the state and national governments. The federal government contributed land and the canal was completed in 1873, passing under federal control in 1891.

The writer had the advantage of arriving in Houghton, "Capital of the Copper Country," and seat of the world renowned Michigan School of Mines, by water, coming through the channel from Lake Superior to Portage Lake, where the country still has a wild and primeval appearance in spots. A few hours after leaving Detroit by steamship, the automobile metropolis having been blistering under a temperature high in the nineties, one's overcoat felt very comfortable on deck in Lake Huron in the evening hours and it was a warming and welcome companion for the next fortnight. As the good ship *Octorara* continued to plough northward into the cold waters, the temperature dropped. Coffee and rolls were succeeded as a matutinal meal by a steak and eggs and a keen appetite for generally more substantial fare at meals was experienced. One did a mile constitutional around the promenade deck to keep the blood circulating. After touching at Mackinac Island for a few hours, the ship headed once more northeast for St. Mary's River and on midnight of the second night out from Detroit was locked through the gigantic single lock of the Sioux Ste. Marie Canal, where in one lift the steamer was brought up to the Lake Superior level.

On the third day the vessel passed the Pictured Rocks of the south shore of the world's greatest fresh water body, the great inland sea of Superior, and all day churned her way westward, passing mighty iron ore carriers downward bound to Lake Erie ports. Some of the craft are 600 feet in length, and constructed with the idea of clear deck space, have from 25 to 30 hatches, into which their heavy cargoes are chuted so rapidly that their "turn-around" time at destination ports is a matter of hours as against the days it requires for transocean ships at Atlantic ports.

In the early evening of a glorious northern summer day, under a sky shot with gold and with startling color effects extending down to the western horizon, we finally doubled the lower end of the Keweenaw peninsula to the southeastward and entered the government channel leading into Portage Lake. The old pilings keeping the channel in bounds showed the effects of many winters of heavy ice, and the foliage and flora observable were seen to be of a northern latitude where old Boreas holds sway for the greater part of the twelvemonth. As one rugged specimen of the climate put it, "We have nine months of winter up here and three months of right coolish weather." It is a clime that certainly puts vim, vigor and vitality into the human frame, in its milder moods, and when once the deeply penetrating frosts are in the ground and the fences are snowed under for the long winter and the automobiles are stowed away, it is a land either to kill or cure any effete tenderfoot living under the moderating influence of the Gulf Stream.

The climate showed the minute we landed from the steamer in Houghton. Now Houghton isn't a very big town as far as gross population goes, some six or seven thousand, but it certainly has a "git-up and git" atmosphere about it, as the late Alfred Henry Lewis used to say, that is engaging to one who knows how hard folk jostle each other to get out of the Subway first, in New York, and then stand on the street curb for five minutes after their mad rush, wondering what to do next. In New York and Chicago people hurry and hurly-burly their way about from habit and from the effects of nervous environment, but in Houghton, or its twin city across the Lake Portage patch of water, Hancock, the climatic ginger working internally causes folk to hustle to and fro from fixed motive.

Fifty automobiles were lined up at the pier to take passengers to their homes in the surrounding towns and they all seemed glad to get back home. One college girl from the University of Michigan at Ann Arbor exclaimed with more force than collegiate elegance, "Gee, I'm sure some glad to get back home up here where you can stretch and take a long breath without busting something!" She greeted her "pops" with a bear-like, athletic hug, leaped into the family car and off they tore for Calumet with true Copper Range "pep."

Up in this region is what would be a shirt-sleeves democracy were it not for the climate. Substantial old clothes take their place for work-aday use, and miner rubs elbows with millionaire in daily contact. It is "Hello, Bill," and "How are you, Dick?" on every hand. At the clubs and for social gatherings, however, one will find the men as smartly apparalled and the women as modishly gowned as would be expected in more metropolitan places. There is an open-handed and open-hearted hospitality and heartiness about the people that one associates with the far west.

The writer was fortunate in having as his cicerone, friend and assistant in obtaining facts and the accompanying photographs to illustrate this article, Mr. Lewis Dixon Knight, manager at Houghton for the Ingersoll-Rand Company, a man familiar with western as well as northern mining in this country and having had experience in South Africa, Australia and South America.

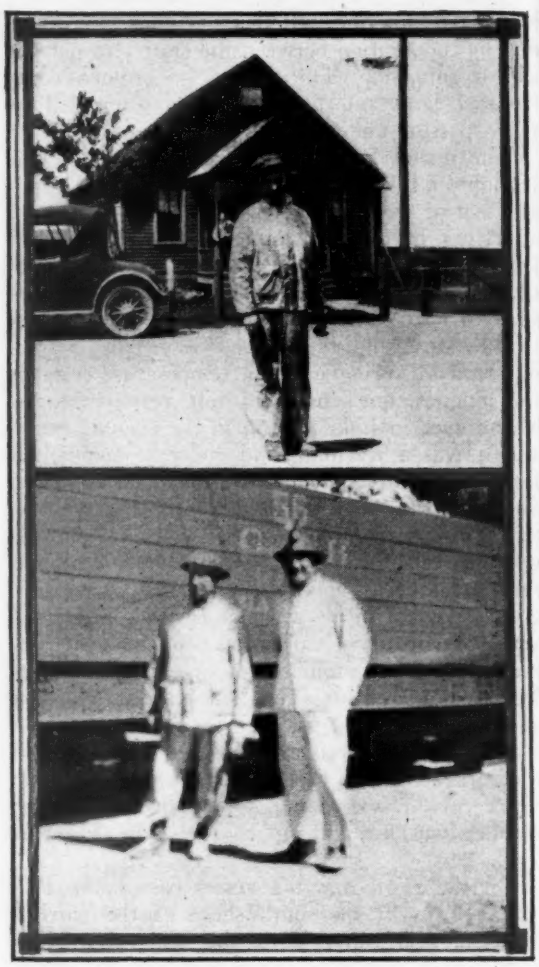
Acknowledgments are made for his highly valued help in motoring us from one mining property to another and making the rounds of the other authorities.

Not the least interesting event, as has been previously indicated, was going underground, the trip having been of three-hour duration. After receiving authority from Mr. John Knox, Mr. Knight and Mr. Samuel Richards, head mining captain of the amygdaloid lode, escorted the writer down No. 15 shaft of the Osceola. After changing from street clothes to underground rigs and being equipped with carbide lamps, we repaired to the shaft, and were presently seated in the front of the skip in readiness to descend into the depths. With Captain Richards it was part of the day's work, with Mr. Knight an old story, with the writer it was a distinctly thrilling incident.

We have shot the chutes, looped the loop, dashed down scenic(?) railways, ascended a mile in an airplane, climbed to the crow's nest and thence to the gilt ball atop a ship's spar, hung over a rocky ledge on a mountain top, ridden out a hurricane at sea, walked an eight-inch plank with a hundred feet of open air beneath us, ascended the Corcovado on a cog road at horrific grade and rounded a sharp curve in the cab of a locomotive travelling seventy-five miles an hour, but from none of these things did we ever derive quite the same thrill as came to us as we shot down that shaft toward China at the rate of 2,000 or more feet a minute.

It was not a bit fearsome, merely stimulating and exciting—a brand new sensation. Rushing down through the rocky walls, with the passage of air fanning one, there comes a feeling of pleasure. One relaxes his muscle tension after a few hundred feet of it and is perfectly willing to keep on going as long as they will let him; willing to let nature take its course. The thought occurred that if the cable broke it would certainly be considerable of a ride into the next world, with the final fireworks at the bottom, thousands of feet underground, only a means of floating off into the eternal ether of illimitable space. This fancy seized our mind for only a second—the rope didn't break!

The skip suddenly came to a jerky stop at the seventeenth level and our musing ended as we stepped out to inspect the true inwards of the mine workings. After our inspection on this level we climbed backward down an ordinary prosaic ladder of scantlings and iron rungs, in hundred foot stretches between the seventeenth, eighteenth and nineteenth levels and from the twenty-third to the twenty-fourth and twenty-fifth levels. Between the nineteenth and twenty-third we rode by skip again, but the other 500 feet was negotiated by leg power alone and with perceptible effect on the back muscles. We are pleased to recall that we returned all the way to the surface by skip.



AT THE TOP OF THIS PICTURE IS SEEN MR. LEWIS DIXON KNIGHT, MANAGER OF THE INGERSOLL-RAND CO., HOUGHTON, MICH., WHO ACCOMPANIED THE WRITER, AT RIGHT OF LOWER PICTURE, UNDERGROUND 2,700 FEET IN THE OSCEOLA MINE, SHAFT 15, UNDER THE GUIDANCE OF CAPT. SAMUEL RICHARDS, AT LEFT IN LOWER PICTURE, CHIEF MINE CAPTAIN OF THE OSCEOLA LODE OF THE CALUMET & HECLA COMPANY.

There were no untoward incidents, excepting that while Capt. Sam Richards was explaining what a safe and healthy life the miner leads, a couple of tons of copper rock in one chunk came bounding down several hundred feet out of upper darkness where some muckers had loosened it and deposited itself not more than a score of feet ahead of us. This wasn't very near, of course, and we admitted it must be a great life,

if one didn't weaken. We could see plainly that for us the hardest part would be the first hundred years in the game.

But they are a fearless, hard-fisted, fighting crew of workers, these mining men, and there is a fascination in their tasks for them, in the conquering of the stubborn rock, in wresting out the metal held in bondage millions of years. They stick with it year after year and with brain and brawn outwit nature. Capt. Sam Richards was a fine type of miner. He was reared within a few hundred yards of the shaft down which he escorted us. He started as a drill boy and has been mining it for twenty-seven years since. He has run the whole gamut of practical copper mining, from timbering to time keeper, and for eleven years has been captain of the six shafts on the amygdaloid lode. He is the idol of his men, any one of whom will cheerfully go out and fight for him on the slightest provocation.

Mining is here conducted first by shaft sinking to the depth required to connect with the lode, then by development along the vein in laterals or drifts. The method of mining in this region is so well known as scarcely to require consideration here. The modern types of water hammer drills are used to bore into the rock for the blasting, the largest proportion of them being Leyners of the Ingersoll-Rand make. Many Jackhamers of the same make are utilized for shaft repair work and foot-wall work and blockholing. The average air pressure used is around seventy pounds. The multiplied uses of compressed air have of course transformed all mining and it has long since become the life blood, a prime essential, of the industry.

The mines have been running in two eight-hour shifts since the armistice, a night shift of from 7 p. m. to 3.30 a. m. and a day shift between the same hours, the blasting being done at night and the fumes being blown out between shifts. In the blacksmith shops of the C. & H. district there are employed 43 Ingersoll-Rand Leyner drill sharpeners, five Waugh sharpeners and two Sullivan sharpeners. Single Carr bits are used by all the mines with the exception of the Copper Range, the Wolverine and the Mohawk, which use double Carr bits in from one-foot to two-foot changes.

The new No. 2 shaft of the Seneca Copper Corporation is an interesting development of the region. This shaft was begun Feb. 15, 1918, the dimensions being 19′ 4″ x 9′ 4″. A great record was made in shaft-sinking, the rates on vertical work for the first five months being respectively, 208′, 195′, 202′, 205′, and 184′, a total of 994′. The inside of the shaft is lined with concrete. Up to May 1 of this year the shaft had been sunk to 1746′ and in July it had reached 1820′. The 600′ radius of this compound shaft is so great that it will be unnecessary to slow up the twelve-ton skips to be used, which will hoist at a speed of 3,000′ per minute. On the curved portion of the shaft its width is one foot greater than elsewhere, or 10′ 4″. The plans are to take out in from five to six years some 5,000 tons of ore in a day of 16 hours, the balance of the day to be used for mending of tools and repairs.

At present there is an eight-inch air line, but eventually there will be a ten-inch line for this property. There is expectation that this shaft will ultimately be driven down to 14,000 or 15,000 feet. The engineers are going ahead on this assumption as though it were an everyday matter.

Mr. Homer Guck, the interesting and energetic editor of the *Houghton Mining Gazette,* who is also an instructor in English at the Michigan School of Mines, gave the writer a dissertation at the Houghton Club one evening on some of the subjects of romantic interest in the region, beginning with the old Quincy mine, which was opened up in 1848. At the time of the Civil War this mine was the largest single copper producer in the United States. It was credited with having saved the Union and the cause of the North at a time when copper went to the highest price on record, 55 cents a pound. This was in July, 1864. Incidentally, just 30 years later the metal went to the lowest price on record, in June, 1894, when it sold at nine cents a pound.

The old power house of the Quincy is now handling 8,000 feet of wire rope on a hoist, but its new and fine power house, which we inspected, will handle 14,000 feet of cable on an incline shaft of from thirty-three and a third to twenty per cent. This working on the Pewabic lode differs from the idea of working on the C. & H., where on the conglomerate lode a shaft runs down vertically a mile to connect with incline shafts.

The general public seemed to have gained a notion that the Lake Superior Copper Country had been on its last legs, Mr. Guck observed, but this was an absurdity. A number of the mines had released a total of several thousand men, many of whom had gone into the automobile industry in the Lower Peninsula, but this lay-off was already regretted, and all of these men and more were wanted back on the Copper Range. The copper in the region is anything but "petered out" and the mines will produce for many years to come.

The old Quincy is still paying dividends and for 54 years it has never failed on a dividend. It began paying in 1862, and since 1868 has never

VIEW OF THE DAM, PART OF THE CANAL, THE COMPRESSOR HOUSE AND THE BLOW-OFF AT VICTORIA MINE.

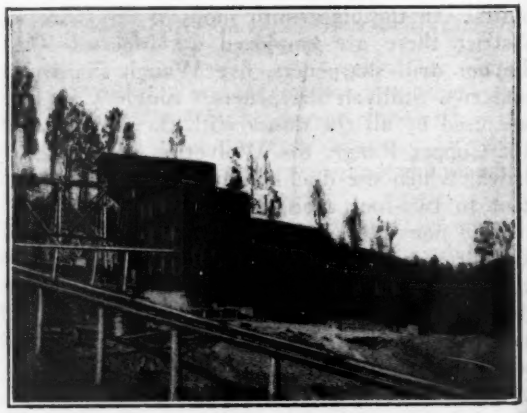
missed a year, there having been a total of 122 dividends, not includinig this year, aggregating $26,452,000. The mine has passed a few quarterly dividends, but never an entire year. And now, although 8,000 feet of incline shaft was formerly considered the limit for depth, the Quincy is promising to go to 14,000 feet—"without batting an eyelash," as Mr. Guck expressed it.

Copper mining conditions differ in Michigan from those of other copper districts inasmuch as the average production is only 16 pounds of copper to the ton of ore, the lowest percentage of copper for the tonnage in the world, but at the same time it is the world's highest grade copper. For the Michigan product the editor of the *Mining Gazette* suggested as the solution of a readier and wider market a great campaign of advertising by the C. & H. and other companies to show that the copper was worth more for certain purposes than other grades. And it is something of a battle to get that high grade copper to market.

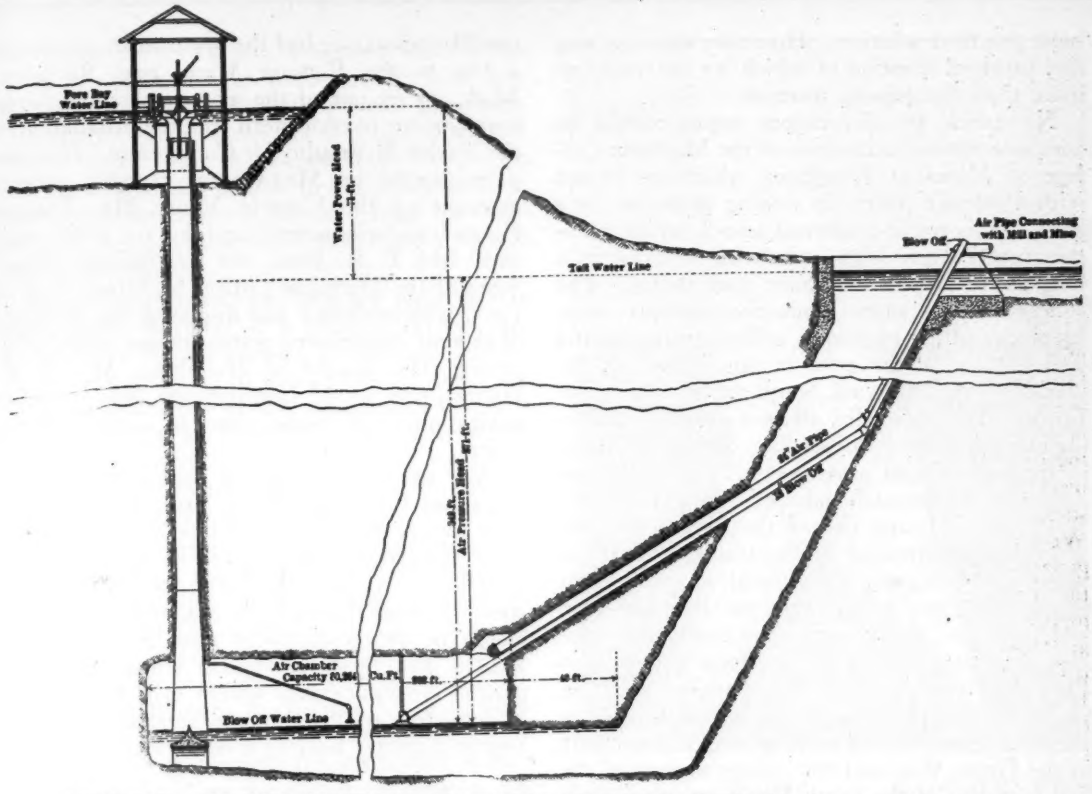
The operators go down a mile into the earth, then drift several thousand feet, in some cases drift a mile, then they drill their holes, blast down the rock, muck it and shovel it into cars, push the cars half a mile or so to the shaft, dump the cars into a skip, hoist the skip a mile to the surface, crush the rock in the shaft rock houses, drop the crushed rock into standard dump freight cars and railroad it all the way from six to fifteen miles to a stamp mill. At the stamp mill it is stamped, ground, tabled, washed, treated by oil or ammonia, and the resulting mineral is taken for another railroad trip to the smelter and converted into ingots. From the smelter the ingots are conveyed to pier and steamer and thence shipped down the chain of lakes to Buffalo whence they are railroaded to the Eastern seaboard. Despite the highest cost of production in the world and the lowest percentage of production to tonnage, this highest quality copper is sold at a profit. There is a world of patience, industry and engineering involved in this long process.

The Michigan copper men never say die! When the Anconda discovery was made thirty years ago and 140 pounds of copper was taken out to the ton, the C. & H. was taking out only 35 pounds to the ton. Many Michigan folk thought their copper operators might as well close up shop and some of the miners started west, but not the operators. They gritted their teeth and stuck with the big show. In a few years Montana was producing more copper than Michigan. Then along came the porphyry mines of Utah and Arizona, constituting another knock on the head for Michigan, but the operators clung to their mines and went ahead with production. Meantime the electrical industry in this country forged ahead with great leaps, just as it did in other countries, and Michigan's fine copper, best suited for electrical work, saw its market grow with its production. And by gum, say the operators, they are going to keep right on producing and selling to a world that knows good copper when it uses it!

Not all of the copper coming out of the district at present has such a high production cost, and there lies an interesting incident. To mine out



STAMP MILL OPERATED BY COMPRESSED AIR FROM HYDRAULIC COMPRESSOR.



VERTICAL SECTION SHOWING COMPLETE SYSTEM OF HYDRAULIC AIR COMPRESSOR.

copper costs about seventeen cents a pound, but the C. & H. is producing perfectly good copper at six cents. For four or five years they have been recovering old sand that formerly went over the jigs into the lake. Now they are dredging out about 640 tons a day of this sand, or tailings, recovering ten to twelve pounds of copper to the ton from what had escaped in a more careless and more affluent day.

More than a year after the beginning of the war, Mr. H. R. Leyden, an electrical engineer, made a report on a proposed Sturgeon River water power development, by means of which the idea has been to supply the greater number of the copper mines with considerably cheaper power for their hoists, compressors and other machinery, thus reducing operating costs, but to date this plan has not been put into effect. I read Mr. Leyden's interesting report of September, 1915, and also an earlier report of June, 1912, by Mr. H. P. Farrington, another electrical engineer who investigated the possibilities.

The day for electrical power throughout these properties, supplied from a common source, may yet come. At present power is supplied generally by low pressure steam turbines. At the Calumet & Hecla and Copper Range mills it is asserted that these installations, only recently made to provide power for regrinding "oversizes" and dredging up the tailings from the lake, give them at small increase in operating costs, sufficient additional power to operate the mills and a surplus to send back to the mines. Other mines have various steam plants, turbines and whatnot, with steam coal to provide at a high price, and the situation is that the heavy machinery at the mines, that is, the hoists and compressors, and pumps that pull water long distances, are operated by steam. The mine managers are agreed that they would like to have electric power throughout for their hoists and compressors, if it could be furnished at an advantageous price.

The serious problem is to supply electric power to special uses. The present steam equipment is very large and very expensive. To replace this by new electric driven machines would require a heavy investment, of course, and therefore a low rate for power to show much advantage. The very large drain on power in starting the hoists can only be overcome by a heavy outlay in special machinery if a direct application of electric motors is used. It would be possible, however ,according to the findings, for a power company to provide compressed air which would permit their present compressors to stand idle as a reserve and to operate the present hoists with air instead of steam, and this idea has been seriously considered. Mr. Leyden, in his report, regarded this as the

most practical solution. However, this is a long and involved question of which we can make no more than this passing mention.

No article on this copper region would be adequate without a mention of the Michigan College of Mines at Houghton, which we visited with Professor Sperr, its mining professor, as a guide. This world-renowned school, which maintains exceedingly high standards, rejoices in a long list of alumni who have done things. The college records show graduates who are managers, consulting engineers, college professors and geologists in all the great mining regions of the world. The Transvaal, South America, Canada, Europe, Asia, Australia, all have sought engineering executives from this school. Among its alumni are high-salaried men now serving in such positions as the general manager of the Lancaster West Gold Mining Co. of the Transvaal; the general superintendent of the Calumet & Hecla mines in Michigan; the general superintendent of ore mines and quarries for the Republic Iron and Steel Co. in Alabama; the consulting engineer for the great Cerro de Pasco property in Peru; the manager of the International Smelting Co. of Utah, and scores of others in high place in the mining world. Alumni played a large part in the Great War and the college organized the first battalion of the 107th Engineers, more than 400 officers and men being furnished the A. E. F.

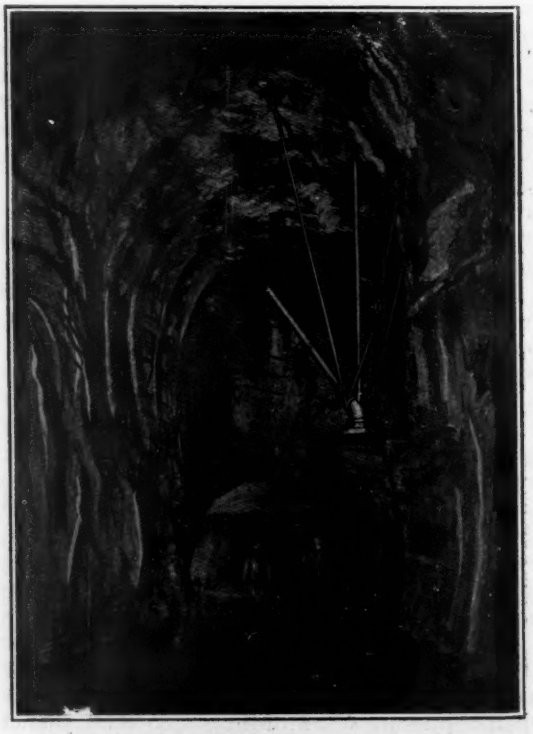
Mr. Herbert Hoover's chief assistant on the Commission for Relief in Belgium was Mr. W. L. Rennold, an alumnus of the college.

It is a small college, located in the city proud to be known as "the biggest little city in the United States." Residents have shown their town spirit and warm regard for the college by contributing liberally to build the gymnasium and clubhouse, in which building is centered the social and athletic life of the college.

The students have exceptional advantages in that they are made welcome in any of the 30 odd copper mines within trolley car distance of the college. Mines, smelters and power plants are open to them. Frequent underground journeys, conducted by instructors, form part of the practical training furnished by the school. The entire time in college is spent in an atmosphere of mining. Both the iron and copper districts of upper Michigan afford unusual opportunities for geological study and instruction. In winter the students enjoy typical northern sports such as skiing, ice skating, tobogganing and deer hunting, while in summer the men have as diversions, canoeing, trout fishing and swimming. The college operates on an all-year basis.

Before leaving the Copper Country and sailing away for Duluth and the iron country of Northern Minnesota, we had the opportunity of making a trip to the Victoria Mine, near Rockland, Mich., to see one of the most remarkable things found on our northwestern trip, the installation of the Taylor Hydraulic Air Compressor. Here we were greeted by Mr. George Hooper, general manager of the Victoria Mine, Mr. Thomas Hooper, superintendent, and by the chief engineer, Mr. E. R. Jones, the well known "Pike" Jones of the Michigan College of Mines, class of 1905, who explained and displayed the workings of this air compressing system to our party, comprising Mr. Knight of Houghton, Mr. A. F. Hahnel, now of the International Machinery organization, with headquarters in Chile, and the writer.

Why the movies have not discovered and photographed for the world this easily accessible and most spectacular mechanical wonder is a mystery. This installation, one of seven on the same principle in the world, is not new, having been constructed about fifteen years ago, and described at length in these columns in years past. For the layman and those unfamiliar with it, this hydraulic air-compressing system may be described as consisting of three intake vertical shafts five feet in diameter sunk to a depth of 330 feet un-



DISCHARGE END OF UNDERGROUND AIR CHAMBER SHOWING SUSPENDED END OF BLOW-OFF PIPE.

derground. Down these cemented tubes flows water of the Ontonagan River, curving over into the shafts at a depth of thirty inches. The shafts lead into an underground chamber into which the falling water sucks in and packs down the air to a pressure of 117 pounds to the square inch, or over 5,000 horse power provided from the compressor's free air capacity of 36,000 cubic feet of free air per minute.

A concrete dam 500 feet long and eighteen feet high crosses the river at a point 4,000 feet upstream from the compressor, and a canal having a cross sectional area of 350 square feet leads the dam to the forebay of the compressor, giving a working head of 71 feet. The shafts down which the water plunges on its long fall of twice the height of the American fall of Niagara, are cemented, leaving a smooth interior.

In the underground chamber is compressed the air by which all the machinery in the mine, including drills, hoists and the stamp mills are operated. When the machinery is shut down, the spectacular part of this equipment becomes apparent. As a safety valve there is a twelve-inch blow-off pipe that leads to the surface. The superintendent, Mr. Thomas Hooper, was kind enough to shut down the stamp mills for our benefit in daytime, so we could see the excitement from a safe point of vantage on the *leeward* side of the blow-off over the river bed down stream. After a wait of about a quarter of an hour, there was a roar and a rumble and a twelve-inch stream of water rose first slowly and then with a rush until it shot skyward to a height of 430 feet, finally spraying out in the wind until the water descended like a heavy rain. Many a spectator has been drenched to the skin when the wind's direction was either suddenly shifted, or else previously miscalculated, but we were fortunate.

We watched the spectacle spellbound for a half hour and then returned for dinner to the mine, looking back fascinated at the powerful stream of water as long as it was in sight. It was worth going hundreds of miles to see. In the dancing sunlight playing on the mist high in air three separate rainbows could be seen.

It is unnecessary to describe the details of the Taylor system, but in the case of this installation, which cost $22 per h. p. for outlay, it is worth noting that the cost of this power averages $2.25 per horse-power year, allowing five per cent. interest on first costs. It is a clever adaptation of an old air compressing method, but of course can only be adopted in a place where the physical conditions make it possible, which places are few and far apart. The pcitures will explain to the reader the Victoria installation. Any reader

ARTIFICIAL GEYSER, OR BLOW-OFF, FROM HYDRAULIC AIR COMPRESSOR AT VICTORIA MINE.

desiring a complete description of the installation may find it in the *Engineering and Mining Journal* of January 19, 1907, to which contemporary we are indebted for the pictures shown.

"Pike" Jones drove with us that evening to Ontonagan, where on the shore of Superior we slept under triple blankets and rose before a chilly dawn to catch a four o'clock train back to Houghton.

The following Sunday night we sailed from Houghton for Duluth, going out to the big lake by the northwesterly channel from Portage Lake. As the steamer passed out by the light-house upon the chill waters of this inland ocean and we looked back, there stood out silhouetted against the sides of hills and mountains along the Copper Range, the buildings of shaft houses, mills and smelters, tall smokestacks pouring their black loads skyward in wreaths that spelled the finish of our visit to a land of fascination, and where at that evening hour thousands of men were toiling and sweating far underground. Long the passengers watched with the collars of their outer wraps turned up, until the scene faded in the dying rays of the sun.

NOTE.—Mr. Tietsort's next article on the Iron Country of Minnesota will appear in an early issue.—*The Editors.*

A New Industry—Making Fruit Butter Under Vacuum

By E. H. ROSEBERRY

UNTIL WITHIN the last few years the demand for concentrated foods, such as evaporated vegetables and fruits, has been so slight in America that food packers have not felt called upon to give the subject serious attention. In most European countries, however, the advantages of evaporation in the preparation of food products have been recognized to such an extent that for years certain foods prepared in this manner have become articles of standard use.

It is only natural that immigrants coming into this country should bring with them a craving for the particular foodstuffs to which they have been accustomed. Their desires, in fact, created almost entirely what demand for foods of this kind existed in this country prior to the war. As these products were not obtainable here, they were imported from abroad. When hostilities began, however, importation immediately ceased. Then it was that the Italians, for instance, were deprived of their tomato products, such as tomato paste, and the American canner was urgently called upon to supply the need.

With the aid of the Italians themselves, suitable equipment was designed and built, and proper methods of production determined upon by experimentation, until within a year a paste of very best quality, retaining the rich red color of the natural tomato without the use of artificial adulterants was made and not only sold, but contracts were made for the next year's output.

Stimulated by their success with tomato products, manufacturers were encouraged to apply the principles of evaporation to the preparation of other products, such as fruit butters. Apricots, peaches, quinces, grapes and others were experimented on, each in turn, until it was conclusively demonstrated that appetizing butters from fruits could be made.

Our following brief discussion deals with the manufacture of apricot butter at the Hemet (California) plant of the California Growers' Association and the process described can be considered typical of the method of manufacture of all fruit butters, with slight exceptions, as practiced by that company, which is a pioneer in this industry.

As indicated by the accompanying plant flow-sheet, (Fig. 1) the fruit from the orchards is first graded, the normal-sized fruit being used for the usual canning purposes, while the under-sized

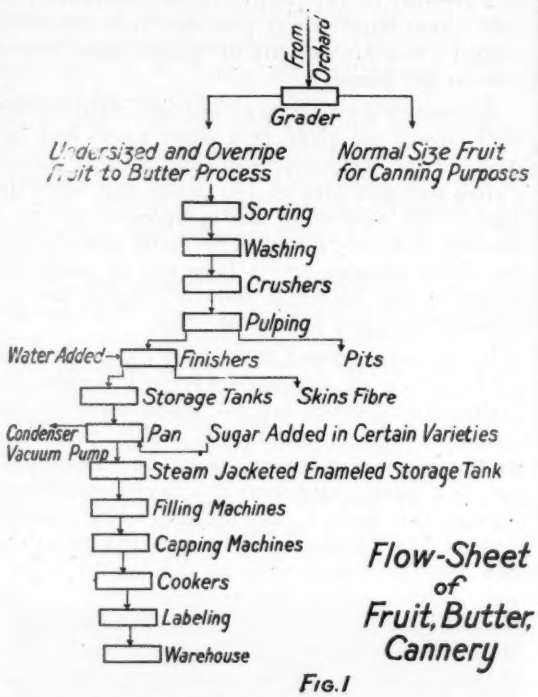


FIG. 1

fruit and fruit that is a little too ripe for the usual canning process is first carefully sorted, then washed, crushed, and pitted in suitable machines, and then conveyed to machines called finishers where the skins and fibre are removed. The skins and fibre are wasted, but the pits are shelled and blanched and the kernels are used to make massage creams, oils, candy adulterants and similar products. With the exception, possibly, of the pitting machines, all of the apparatus referred to is standard cannery machinery.

The pulp leaving the finishing machine is now diluted with water so that it can be pumped by centrifugal pumps into storage tanks. The percentage of moisture after dilution is about 90%, but much of this is made up by the natural fruit juices, practically all of which is caught and retained in the course of the various crushing processes.

The storage tanks are usually situated slightly above the vacuum pan and generally are several times the capacity of the pan itself. Thus the latter can be filled, either with, or without the vacuum on the pan.

As the pulp is introduced into the evaporator

sugar for sweetening is added when making apricot butter, but not all products require this sweetening.

It is in connection with the evaporator system that special attention is called. Quality, of course, for the finished product is always desired, but the rate of production is a very important factor. Early experiments were made on open kettles heated with steam coils or jackets, but two important objections prevented any extensive use of the open type of kettle. One of these is the high temperature at which boiling takes place at atmospheric pressure, which fact frequently causes the product to lose its natural color through oxidation, and the second is the length of time required to evaporate a given quantity of moisture. The vacuum pan quickly found favor and several types were built.

One of the most successful pans is spherical in shape, (Fig. 2) steam-jacketed, and built of

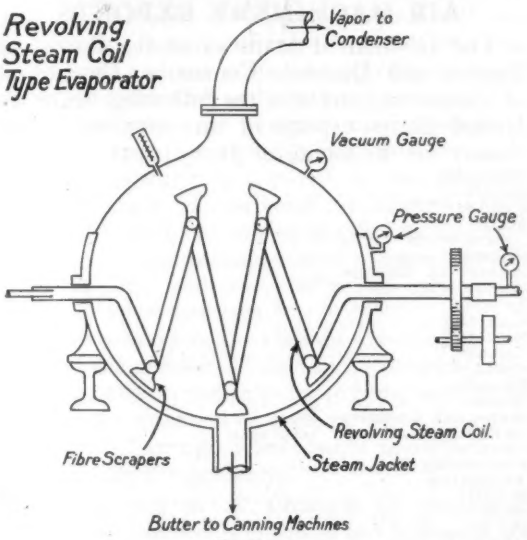


Fig. 2

acid resisting material such as bronze and copper with a steam coil arranged with stuffing boxes where the coil enters through the shell of the pan so that this coil can rotate and act as an agitator in addition to heating the contents of the pan. Fibre brushes attached to the coils which revolve at the rate of about ten revolutions per minute automatically scrape the bottom of the pan, thus preventing the formation of a crust which would result in burning.

Another type of pan is made of glass-lined steel with stationary coils, one or more of which can be put in service as the required rate of boiling varies. (Fig. 3).

The sketches indicate the principle involved in each pan.

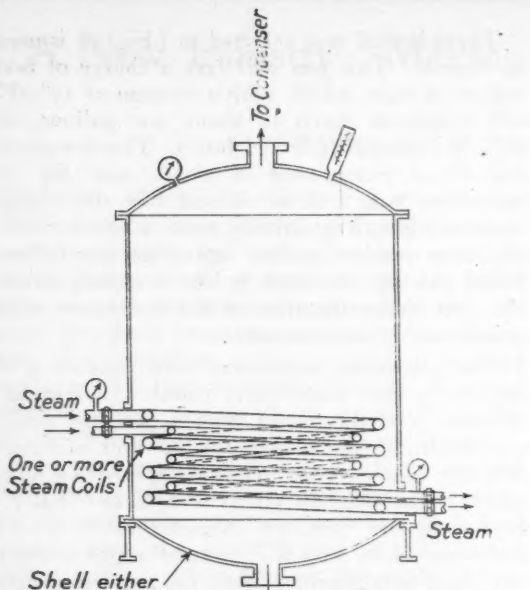
The spherical type referred to (Fig. 2) is used at Hemet. This pan will take a charge of 600 gallons of pulp, which, with a vacuum of 27"-28" will evaporate down to about 300 gallons, or 50% in approximately 1¼ hours. This is equivalent to an evaporation of about 2400 lbs. of liquor per hour. It is claimed that the evaporator will handle practically twice as much water per hour under similar operating conditions. Steam pressure at about 80 lb. is usually available, but this is throttled at the evaporator coils to suit boiling requirements.

The condensing equipment used consists of a size No. 5 steel plate Beyer counter current barometric condenser fitted with a patented moisture separator for drying the air and non-condensable gases before removal by the vacuum pump. The vacuum pump is a Class "ER-1" high speed dry type, 22" diameter by 8" stroke and is driven by a 25 h.p. motor through a short belt drive attachment. Both the condenser and the vacuum pump were furnished by the Ingersoll-Rand Company. They are of such size that several additional evaporators can be served as the plant requirements increase. With this equipment a vacuum of 27-28" mercury is maintained with cooling water available at 70°-80° Fah., using an average of four gallons cooling water per pound of steam condensed.

To guard against loss by entrainment, in case of accidental boiling over of the pan, the vapor pipe is constructed with a bend, as shown by the drawings. A drain from this bend back into the pan was used to recover the liquid entrapped in the vapor pipe.

Ordinarily, this construction of vapor pipe is to be avoided, as, should the valve in the drain pipe be left closed, or the drain pipe be choked up with pulp, the trap immediately becomes inoperative and impaired vacuum may result. It is better in cases of this kind to eliminate the bend entirely, carrying the vapor pipe directly to the condenser. If entrainment still occurs, increased vapor liberating space must be provided, if necessary reconstructing the pan, or the rate of boiling must be decreased.

After the liquor is evaporated to the desired consistency, as found from samples taken during the course of evaporation, the vacuum is broken by means of a vent, and the mass now weighing about 12 oz. per gallon heavier than water is dropped by gravity into steam jacketed enameled tanks where it is maintained at the heat at which it is expelled from the pan, then passed to filler and capper machines where it is packed in tin cans. These cans are next tested for leaks, then conveyed to standard cookers, where their con-



Stationary Steam Coil Type Evaporator

FIG. 3

tents are sterilized at a temperature of 200° F., and finally are labeled and packed for shipment.

Butters from other fruits mentioned are made in a similar manner to that described for apricots. The general process employed differs chiefly in the time required for concentration to the required consistency.

In all probability still other fruits will be experimented with, for evaporated foodstuffs of this kind have a value which is only indicated by the following more important reasons:

(*a*) Concentrated fruits cost less than fruits as ordinarily canned. Probably the chief reason for this is the nature of the ingredients used. Ordinarily, canning fruit is normal, or large sized, and of good quality. Fruit for butters can be under-sized, or slightly over-ripe, although only good quality is used, free from adulterants. Again, because of the concentrated nature of the product, freight rates to distribution points are materially reduced, thereby having no small effect in fixing low net selling prices. In the case of apricots, for instance, a 12 oz. can of butter is equivalent to about three pints, or about three pounds of the canned fruit, yet the same 12 oz. can sells for very little more than a pint can of the canned fruit.

(*b*) The development of this industry is an important step in food conservation. Formerly, part of the fruit not actually canned was dried and put on the market in that form, but much that now can be used was considered unsalable and was accordingly wasted.

For the present, the preparation of canned fruits as ordinarily practiced will undoubtedly continue unabated. As fruit butters become more generally introduced, however, it is felt that this new industry will grow rapidly, particularly when the consumer realizes that he is absolutely protected by strict government inspection against the use of improper ingredients, or by other means that would make for any but a strictly pure article.

Pioneers in this line, therefore, look forward to a big demand for their products. In fact, it is very gratifying to them to have their products so well received that this year's total output already has been contracted for and only their limited means of production prevents them from marketing considerable more.

AIR MACHINERY EXPORTS

The Division of Statistics of the Bureau of Foreign and Domestic Commerce, Department of Commerce, furnishes the following figures on United States exports of air compressing machinery for the month of June, 1919:

Countries	*Dollars*
Belgium	15,257
France	128,971
Italy	79,415
Netherlands	5,892
Norway	4,709
Russia in Europe	6,750
Spain	74,644
Sweden	1,446
England	43,401
Scotland	1,441
Canada	40,405
Costa Rica	18
Panama	1,166
Mexico	12,373
Miquelon, Langley, etc.	1,000
Newfoundland and Labrador	112
Cuba	20,419
Dominican Republic	90
Argentina	10,891
Brazil	20,141
Chile	2,497
Peru	857
Uruguay	700
Venezuela	2,250
China	323
British India	5,018
Dutch East Indies	3,175
French East Indies	7,341
Japan	68,992
Australia	5,593
New Zealand	450
Philippine Islands	6,731
British South Africa	3,270
Portuguese Africa	132
Total	$575,870

It is announced from Buenos Aires that the All America Cables system controlled by the Western Union Telegraph Co. has completed the laying of its new cable in the River Plate. This will connect New York with Montevideo via the cable extending through Colon. The new cable is now in operation.

How a Great Export Trading House Handles Machinery Sales

By GEORGE H. COE

The operations of the great house of Messrs. W. R. Grace & Co., which typify American enterprise in many parts of the world, include the handling of many lines of intricate and expensive machinery for their clients. Each year the Grace organization exports for American manufacturers millions of dollars' worth of machinery equipment, machinery that enables other countries to produce outputs for their own home consumption and also for exportation to us, enabling them to pay for what they buy, in the ordinary workings of economic laws. In the current issue of the "Grace Log," the ably edited house journal of the company, there appears the subjoined article on the subject, which we are permitted by their courtesy, to reproduce. The company does a brisk business in air compressing machinery, drills, tools and other pneumatic equipment. THE EDITORS.

W. R. GRACE & CO. started in the machinery business in 1886, although for many years previously they had been handling machinery indents for clients. The development of the machinery business was confined exclusively to the West Coast of South America, and therefore followed the lines of development peculiar to that territory.

The tendency to change from primitive methods in agricultural, mining and other activities, naturally brought the first development of machinery into the lines of frontier equipment, such as log mills and saw mills, and agricultural equipment for harvesting and preparing the product.

No facilities were available to the people of South America for securing local information as to the equipment they required, nor for obtaining such equipment. Consequently, machinery of this class was brought in only as specified by local proprietors who had perhaps visited countries further developed, or from the reading of agricultural papers or advertisements.

In the year 1886, the Chilean Government recognized the necessity of having improved agricultural equipment, and in order to bring such equipment to the attention of their people, held an exhibition in Santiago where many manufacturers displayed their machinery.

At that time W. R. Grace & Co. decided to go into the machinery business in Chile with the agency of the J. I. Case Threshing Machine Company for grain threshers and portable engines; the McCormick Harvester Company for reapers, binders, mowers and rakes, later adding stump pullers, hay presses, log mills, flour milling equipment, wood working machinery, and finally modern riding plows.

This machinery business was carried on in Chile in a specialized and highly organized manner, and contributed largely to the wonderful agricultural development in that country. Other lines of machinery were not handled except in a hit or miss way on a commission basis, until 1900 when, due to the Grace interest in the proposed electrical development at Lima, Peru, it was decided to take up the sale of electrical apparatus, and in 1902 an exclusive sales agency arrangement was made with the General Electric Company covering Peru, Bolivia and Chile.

A sales engineer from the General Electric Company was placed with the organization on the West Coast of South America to advise prospective customers as to their requirements in these lines, and to supply technical information and service on the equipment. Within a year it was found that one sales engineer was not sufficient and another General Electric man was engaged so that one could be permanently located in Chile and the other in Peru. During the next two years it was found that the handling of electrical apparatus involved other classes of machinery such as water wheels, steam engines, boilers, pumps, hoists and general mining equipment, and agencies covering these lines were taken on and other technical experts added to the organization.

In 1907 the machinery business was extended to cover the nitrate district with technical organizations at Iquique and Antofagasta; also into the mining districts of Bolivia with technical organization at La Paz. A technical department was established in New York to co-ordinate the operations of the various branches, and supply the services necessary for their operation. Messrs. Grace Brothers & Co. also added a technical staff to their organization in London, while the New York House supplied the machinery branches with information on machinery from England or the Continent, and selling to the various purchasing offices in London.

From 1907 to 1912 the growth of the machinery business was rapid, and in 1912 it was decided to separate this business in Chile, and the International Machinery Company was formed. All of the machinery lines outside of the agricultural machinery were turned over to the International Machinery Company, with jurisdiction over Chile and Bolivia. The formation of the International Machinery Company enabled our machinery business to still further expand, especially in merchandising lines, and a large business developed in electric motors and supplies, and general mechanical supplies distributed from stock.

Practically all of the machinery on the West Coast of South America has been supplied from the United States, Great Britain or Germany. At the start the United States had the lead on electrical plants, agricultural machinery, railroad equipment, and possibly on primitive sugar machinery; whereas England predominated in general industrial machinery, engines, boilers, pumps, hoist machine eools, etc. As time passed the United States began to get a share of the general machinery business, Germany a share of the electrical business, and England an increasing proportion of railroad equipment due to the British Railroads. The year 1914 found Germany securing the bulk of the electrical apparatus and equipment, especially in Chile; England having most of the business in sugar machinery, and the United States gaining a larger part of the general industrial machinery, the equipment for railroads being supplied principally from England and the United States.

At this time Brazil was almost exclusively supplied with machinery from Germany, except railroad equipment which was principally English; whereas in the Argentine the United States supplied the bulk of the agricultural machinery; England the bulk of the general industrial machinery and most of the railroad equipment; and Germany almost all of the electrical and power plant equipment.

Consideration had been given by W. R. Grace & Co. to expanding the machinery business to the East Coast, but this was not considered practical until the German supply had been shut off in these markets. Therefore, in the latter part of 1916 a railway supply salesman was dispatched to Brazil to solicit business from the railways there, and in May, 1917, the International Machinery Company was opened at Rio de Janeiro to take care of the general machinery business in Brazil. One year later the International Machinery Company was opened at Buenos Aires, so that the Grace machinery business is now well established in all parts of South America.

In the latter part of 1916 a machinery department was established at Barcelona, Spain, and while war conditions held up the development of this territory, it is now increasing its activities.

Within the last year it was decided to engage in the machinery business in India, and on June 27th, of this year, Grace Bros. India Ltd., put into operation the British American Machinery Company, Calcutta.

In general the machinery organizations are handling all lines of machinery used in the various markets, but some of the more recently established organizations are concentrating on certain lines only. On the West Coast of South America the principal lines are those of the General Electric Company, and the Ingersoll-Rand Company, with an important movement in sugar machinery, textile machinery, railroad equipment and supplies, mining machinery, and power plant equipment. In Brazil and the Argentine the principal items are sugar machinery, textile machinery, railroad equipment and supplies, machine tools and woodworking machinery. In Spain the lines so far developed consist principally of machine tools and small mechanical tools.

The Grace machinery organization has supplied equipment for many important installations leading to the development of the countries in which they are installed; the Empresas Electricas Asociadas at Lima comprises two hydro electric stations, one steam generating and distributing station, four railway sub-stations; also a tramway system of several interurban and urban lines covering about 73 kilometers of track; equipment for the electric tramway at Arequipa, Peru; the material for the construction and equipment of the steam railway from La Paz to Oruro; the material for the construction and equipment of the electric railway from the Alto in La Paz down to the city; the designing, supplying of material, and construction of the Oficina Paposo, having a capacity of 4,000 quintals of nitrate per day; the construction of the electric railway and power plant of the Bethlehem Chile Iron Mines Company at Cruz Grande, Chile; the complete equipment and construction of the Concepcion Electric Company at Concepcion, including the interurban lines from Talcohuano; the electric equipment for the electric railway from Santiago, Chile, to San Bernardino; in Argentina, for the Compania Hilanderia de Argentina, the complete machinery for a cotton mill having 2,760 spinning spindles and 1,120 twister spindles; for the Compania Azucarera, Concepcion, a new 14-roller sugar mill having a grinding capacity of 1,800 tons of cane per day. In Brazil, for C. Rios & Co., Uzina Terra Nova, a sugar mill of 11 rollers having a grinding capacity of 700 tons of cane per day, and complete new equipment for boiler house; for A. Soveral & Co., Uzina Colonia, a 3-roller sugar mill of 350 tons grinding capacity, and complete equipment for boiler house.

Australia is going in for more shipbuilding at home. The Government is asking for proposals for the construction in Australia of four steamships of 10,000 tons each. The plans prepared call for vessels 450 feet in length, of 56-foot beam, with 150,000 cubic feet of space for refrigerated cargo, and for a speed of 12¾ knots per hour.

The Future of the American Merchant Marine

By J. A. KISSICK
Assistant to President, Chester Shipbuilding Co., Ltd., and Comptroller, Lake Torpedo Boat Co.

"Our opportunity is here today to build up a great merchant marine, to carry American goods once more in American ships to all parts and ports of the world."

THE HISTORY of American ship-building and shipping from colonial days has been characterized by successive periods of progress, brilliant achievement, decline and partial recovery.

The causes for this varied history are themselves various: some economic, some competitive, some the result of natural forces—the presence of great forests of timber on this continent at a time when all ships were built of wood; the rise of the steel industry in a competing nation at a time when steel was beginning to displace wood on the ocean; wars; the payment by others of greater subsidies than this country was willing to pay. Competing ships of another flag; lack in this country at a critical period of an intelligent public opinion to stand behind the merchant marine, and latest, a great emergency which put Americans on their mettle as no other event has ever done—all have played their opposing part in the story at one time or another.

One notable period in our history stands out above all others; the time preceding the Civil War, when we commanded the sea by building ships of better model, manned by more efficient sailor-men who earned better wages than any one else would pay, and by the lead taken in mcehanical devices for speeding the loading and unloading of cargoes. Merchants and traders in this period all over the world paid higher rates for shipments in American ships, and paid them cheerfully, because the swifter, better service was worth it.

That was almost a perfect example of the progressiveness upon which Americans pride themselves. We may now call attention to the elements that entered into it and made for success. It is no mere coincidence that these same general elements of the situation are facing us today, and calling upon us to show whether or not American progressiveness and initiative are still with us.

But—just as American progressiveness, without the support of a strong public opinion and a wideawake Government, did not save the American merchant marine in the crisis of the Civil War, when the Confederate cruisers were sinking American ships in every sea, so likewise we cannot succeed in our present effort if American initiative and progressiveness are not fully supported in every way possible to meet the advantages which foreign nations, in one way or another, lend to their merchant marine.

J. A. KISSICK

Our opportunity is here today to build up a great merchant marine, to carry American goods once more in American ships to all parts and ports of the world, and it is a time in which we can all help in the formulation of the right policy, at least, by electing or supporting for office those who will work and plan loyally for the development and maintenance of such a fleet as will fulfill our high hopes.

For the construction, maintenance and continued success of an American merchant marine, we must have—in some cases we already have, or are soon to have—

(1) A large, successful and continuing shipbuilding industry, intelligently safeguarded and attaining a high degree of efficiency through progrissive and standardized methods, backed by the loyal coöperation of a well-paid and contented army of labor, and by substantial and direct Government support if, and as long as it is necessary.

(2) Organizations operating and conserving

ships on a plane of efficiency high enough to compete successfully with those of other nations as proposed in general by the United States Shipping Board.

(3) A well-worked-out plan for the development of our port, terminal and storage facilities on the most modern scale, so that we may again lead the world in safe, speedy and economical handling of cargoes, and may, through reducing the "turn-around," keep our fleet of ships going at their best speed.

(4) Banks and bankers willing and able to provide the funds necessary for financing, on the broadest scale, not only shipping, but the entire structure of export and import trade. This includes the establishment of branches of leading American banks in foreign countries, such as is already, in some cases, under way.

(5) Legal authority for firms and individuals engaging in foreign trade to combine for their mutual advantage for greater efficiency and economy of operation. This has already been given under the Webb Act.

(6) A broad education of our manufacturers and merchants of every kind in the possibilities and requirements of successful overseas trading.

(7) The building up of a well-balanced trade by increasing our imports of commodities, for manufacture, re-export or home consumption. We cannot sell to all the world without being willing also to buy and our ships need cargoes homeward as well as on the outward voyage.

These may all be reduced to six fundamentals: (a) markets, foreign and domestic; (b) cargo movements to and from ships; (c) movement of ships with cargo or without; (d) financing; (e) legislation; (f) a broad general policy of construction development.

But without ships, the other five fundamentals are at the mercy of the foreign nations who possess them, and they thereby fall heir to the trade opportunities we surrender.

To give up the best of our ships and shipping to foreigners, and to rest content with such service as they may see fit to supply, would be almost as bad as though we sold our railroads to foreigners, or permitted them to send over their equipment to operate on the lines we had built for ourselves.

The ship problem has been under study since the war started in 1914, and especially since 1917 when we came into it just at the height of the enormous destruction by German submarines.

Mr. E. N. Hurley, the lately resigned chairman of the United States Shipping Board, has several times published reports and statements giving the official view of the United States Government on the situation and some of his figures are interesting.

At the outbreak of the war, for instance, the total steam sea-going merchant tonnage of the world (exclusive of Germany, Austria and Turkey) was 34,924,000 gross tons. After four years of submarine and mine destruction, captures and ordinary and extraordinary accidents of the sea, 15,218,000 tons of this had been lost.

But in this time 11,856,000 tons had been built in the shipyards of neutrals, Great Britain, France, Japan and the United States, Canada and Australia, and 2,393,000 tons captured from the enemy, so that at the end of the war the Allied and neutral merchant fleets still stood at 33,956,000 tons. But while at the beginning of the war the United States possessed only 1,758,465 tons of the greater total, at its close, owing to its captures of German ships, and the wonderful output of its shipyards, it possessed 5,231,473 tons, and to-day stands as "potentially the greatest maritime power of the earth, for the reason that we possess the greatest shipbuilding instrumentalities."

What are we to do with this great fleet of the present, to say nothing of the potentially far greater fleet of the future? In a later address, Mr. Hurley sums up the possible policies as follows:—

(1) Government ownership and operation.

(2) Government ownership and operation through the medium of a private corporation, similar to the Emergency Fleet Corporation.

(3) Government ownership and private operation for Government account, the private operator acting merely as agent for the Government.

(4) Government ownership and private operation for private account; the ships being chartered or leased to private firms at a fixed rental.

(5) Ownership by a single enormous, but private corporation.

(6) Private ownership and operation on the basis of unrestricted private enterprise.

Which is to prevail? Mr. Hurley has unreservedly advocated the return to private enterprise, holding that only with the greatest degree of freedom and incentive for American individuality and initiative, can the problems which still lie before us be brought to a solution.

Such expressions of opinion as have come from tries, show plainly that in overwhelming majority, they agree with Mr. Hurley, and that the industries are fully conscious of the responsibility which, by adopting that solution, they will be assuming toward the entire people of the United States, whose interest in this great problem is peramount.

Much remains to be done, hopeful as the prospect is. Foreign trade and shipping must, hereafter, be more than the interest of the banker and capitalist, or the manufacturer looking for new markets. They must become the intimate concern of every American, who must learn, once and for all, that in the foreign trade of his country is bound up the well-being of his country, and that the well-being of his country means, in the long run, his own success and welfare.

BUREAU OF MINES DEDICATION

Just as these words are scheduled to greet our readers the new Pittsburgh laboratories of the Bureau of Mines, which have cost more than a million of dollars, are being dedicated with elaborate ceremonies in which prominent representatives of the mining and metallurgical industries very properly participate.

The dedication ceremonies, commencing Monday, Sept. 29, bring to Pittsburgh for the three days the most important mining and metallurgical men of the nation, and an elaborate programme of events has been prepared which includes the presence of high national and state government officials.

It is not permissible, through lack of space, to rehearse here the programme in detail, but attention may be called to the most prominent and specialized feature, the mine rescue and first aid exhibits and contests.

The formal and elaborate ceremony of dedication occurs on the beautiful lawn in rear of the laboratories, Dr. Van H. Manning, Director of the Bureau, presiding. After the invocation by Dr. S. B. McCormick, Chancellor of the University of Pennsylvania, comes the address of welcome by Hon. E. V. Babcock, Mayor of Pittsburgh, and response by Hon. Franklin H. Lane, Secretary of the Interior, followed by addresses and then the formal ceremony of handing over the keys of the building by Secretary Lane to Director Manning.

Then after luncheon a special train takes the guests to the Experimental Mine at Bruceton, Pa., and there a pre-arranged explosion of coal dust takes place as a demonstration to the visitors and after that comes an inspection of the mine and the explosives testing plant.

In the evening, after the return from the mine, there is a general meeting at Carnegie Music Hall under the auspices of the Pittsburgh Chamber of Commerce, with an address by Secretary Lane, an organ recital, and the first showing of a new moving picture, "The Story of Coal."

All this and much more, in the way of luncheons and things, on the first day. On Tuesday come the elimination contests in the National Safety First-Aid Meet and the awarding of State championships, then a demonstration of the explosibility of coal dust and at night the Chamber of Commerce presents a pageant typifying the spirit of the mining industry, with music by the band of the Carnegie Institute of Technology.

On the last day occur various contests, another great coal dust explosion and a smoker at the Chamber of Commerce in which prizes will be awarded and various speeches made.

The Laboratories surely get a good send off.

Air Machine at Polytechnic School

The Benson Polytechnic Institute of Portland, Oregon, a combination of technical and trades school, has a rather complete machine shop and foundry for the use of its students. The students have the benefit of the installation of a class "FR" compressor, 9x9x8, built by the Ingersoll-Rand Co. This machine supplies compressed air for the machine shop and foundry and has been found of great value for demonstration purposes. A large number of technical schools throughout the country have purchased air compressing equipment, having found it indispensable in their mechanical engineering courses.

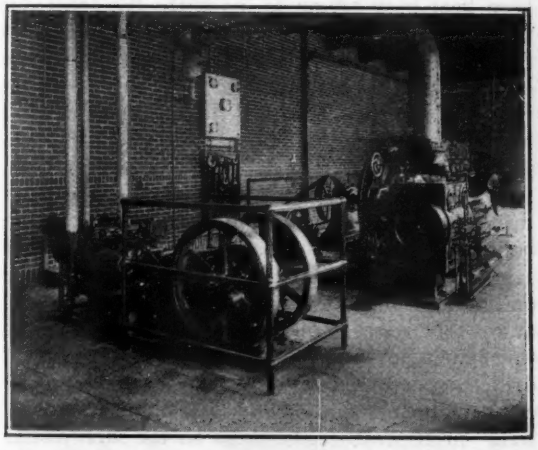


Photo by Courtesy Benson Polytechnic Institute.

Harry M. Giles has been appointed general superintendent of the South Philadelphia Works of the Westinghouse Electric & Manufacturing Company. Mr. Giles, who succeeds the late Oscar Otto, killed recently in an automobile accident, has risen from the ranks in the Westinghouse organization. For a number of years he was superintendent of marine erection, a position to which he was appointed by H. T. Herr, when the electric company absorbed the machine company.

Survey of the Technical Field

Edited by FRANK RICHARDS

KEEPING MACHINES IN CONDITION FOR THE SHARP STEELS*

CONSIDERING the amount of steel which has been sharpened by writers in mining papers in the last year, there should be a large percentage of the drills in good condition. This being the case, would it not be a good idea to repair a few machines, and get them in condition to use this sharp steel?

The ability to take a pencil and figure out how deep a drill will penetrate the rock at each blow is not mine. From the time I used air drills on which the chuck wrench was nearly as heavy as the up-to-date machines, to the present, I have been kept busy trying to make the boss pull out a little more tape line each month and use a little less powder to pull the ground. So I have had no time to get down to 1-16 and 1-32 in. for each blow. The dark, deepcut holes that would break were of more interest to the employer.

Writers on the subject never mention whether the tests have been made in a snow bank or in boulder granite, and consequently it is hard for a miner to tell whether he is keeping up to date or not. If the bit penetrates the rock 1-16 in. at each blow, as some say it will, then the old timer will have to go, together with the piston drill, to the junk pile; as eight blows should clear the hole to *that depth,* 1200 blows a minute, well—pretty fast. The slides on the shell would begin to warm, and a motor would be needed on the feed screw.

No good drill man will use dull steel when he can get sharp steel, but there are times when it is necessary to fight a hole with dull steel for a few inches, when the steel is cut up into different lengths. In the shop, as a rule, drills are so made that one steel has to be run out before the next one will take hold. Should the gage become worn and the bit dull, on a starter or second before it is run in full length, one of the same kind will not go into the hole, as it is too large. The longer one will not go because there is not room; hence the dull one must be run out. This often happens in hard ground.

Many drill men are better off with dull steel than with sharp, as they cannot drill as deep holes with the dull steel, and consequently cannot get as much powder in them to waste. They put their holes in the easiest and most convenient place they can find, caring little how much ground they pull. All they are there for is to get in the shift. The question of footage never enters their gray matter.

MACHINES MUST BE IN GOOD CONDITION

There is no doubt that sharp steel is better than dull; but, if the machine has not the "kick," the work will not be up to the standard, regardless of the drills. The managers and superintendents of most mines give little or no attention to keeping the air drills in proper condition. They have the impression that as long as a machine will run it is all right, provided there are sharp drills.

In many mines the following conditions or similar ones prevail: A drill runner goes to his place of work when he goes on shift. In due time he gets a steel in the chuck and is ready to drill. He opens the throttle. The hammer may not strike a blow, or it may not hit with any force. The night shift has done something to it. The drill man on shift takes a monkey or Stillson wrench and goes after it. In taking it apart he loses the pawl plungers. The pawl springs look bad; the pawls are worn and the rifle bar is in bad condition. After a search for a cager or nipper, he sends for the parts, which *he thinks* the machine needs. By the time he gets the drill working again, from two to four hours of the shift are gone. No drilling has been done, and $10 worth of new parts have been used. In this case a sharp bit will accomplish no more than a dull one.

Another drill man finds himself in the same condition, but not being of a mechanical turn of mind he looks for another machine, and, if lucky enough to get one, sends his own on top. It eventually gets to the blacksmith shop, where it is thrown in the dirt until the blacksmith, his helper, or possibly some surface employee has time to work on it. It is put in the vise or, more often lies on the floor while being repaired. It is taken apart, cleaned and put together with a few new parts from the storeroom—always new parts —at an expense of from $1 to $30, and the old parts are thrown on the junk pile.

Is this drill in good condition when it is returned to the mine? No one knows. There is no way of testing it in the shop. When the drill runner gets it he knows whether it has a good "kick" and if it rotates properly, but he knows nothing about the amount of air used to operate it. The air may be leaking through some part of the drill, or the valve may not be cutting off properly.

The idea that an air drill is "fool proof," and that any person on the job can repair it, is a mistake. A drill must be cared for properly, as well

*Harry E. Scott, Johnson, Arizona, in Eng. and Mining Journal

as any other piece of machinery. No matter how good the operator, it needs overhauling at certain intervals, in a shop fitted for that purpose and provided with a meter for testing the amount of air used. When a compressor making 2000 cu. ft. of air a minute has to be run at maximum speed to furnish air to a number of drills which, if in good condition, would use only 1500 cu.ft., there is something wrong. In most cases it will be found in the air drill.

AIR DRILL REPAIR MAN

The air drill repair man, or machine doctor, as he is often called, is an important factor. The best repair men are those who have had a few years' experience running machines, and who are handy with tools and mechanically inclined. They know from experience the work to be done, and realize the troubles of the runner, which are many. A man of this kind who had become familiar with the cost of drill parts, and learned to throw nothing away that could be worked over and give efficient service, took a job. During the first 10 days he picked up over $900 worth of drill parts from the dump and junk-pile. These were used, and gave as good results as new parts from the storeroom would have done. They had been thrown away by the man who was repairing drills; and it had taken him only a short time to do it, and with only 16 machines on the job!

Any property using a small number of air drills can support a good repair man—one who can keep the drilling speed up (with sharp steel) and the maintenance cost down. With the machines in good condition, sharp steel, plenty of air and the right man on the crank, there should be no kick from the office concerning the number of feet drilled.

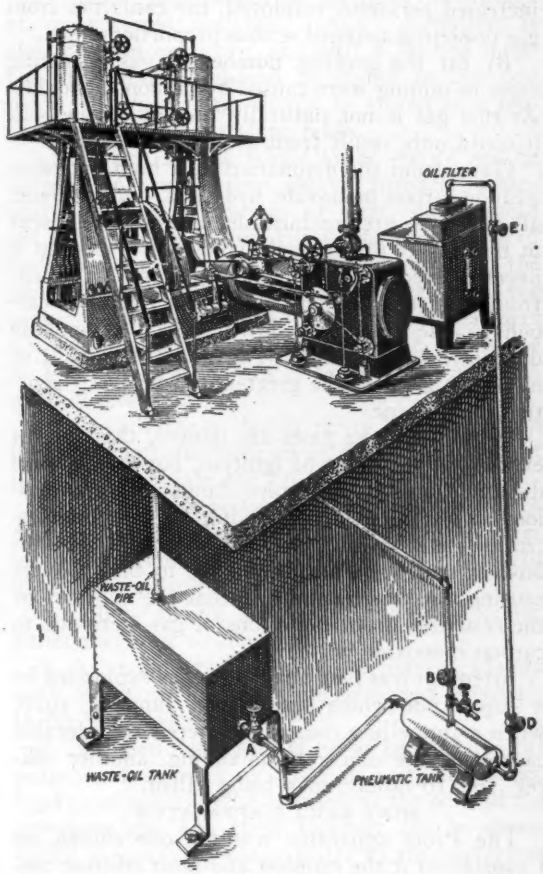
PLAN TO AID MINING SCHOOLS

A bill was recently introduced into the United States Senate providing for the expenditure of $25,000 per year in each State to aid mining schools, the money coming from sales of public lands. The equal opportionment to each of the states may not seem most wise or profitable, but it seems to be the only arrangement possible to put through. The government aid will be "for instruction, research and experiment in mining machinery, mining engineering and treatment, metallurgy, assaying, chemistry and geology."

One of the principal aims of the bill is to study the prevention of explosions, fires, etc., and to promote the general welfare of miners and operators. For the scheme as outlined the appropriation is so absurdly inadequate as to be utterly worthless, but somebody may get the money.

ENGINE ROOM EQUIPMENT FOR HANDLING OIL

The cut here reproduced from a recent issue of *Power* shows, with a clearness which renders description superfluous, an easy and cleanly means of handling the otherwise waste oil from steam engines and other machines. It was installed by the writer (C. J. Domville, Port Hawksburg, N. S.), and handles all the oil from four engines and two refrigerating.



The oil is conducted by suitable drains to a galvanized-iron tank in the basement, from which it is drawn through the valve *A* into the pneumatic tank, which is a 15-gal. heating boiler. The valve *C* is left open to vent the air during the filling processes. After the pneumatic tank is filled, valves *A* and *C* are closed and *B* and *D* opened, air from the compressed-air system being admitted at *B*. By means of the valve *E* the operator regulates the flow of oil to suit the capacity of the filter.

MINE RESCUE WORK ON THE WESTERN WAR FRONT*

By Lieut. Col. D. DALE LOGAN, D. S. O., M. D., D. P. H.

I FIND that it is difficult to make people appreciate the very extensive scale on which mining operations were carried out on the Western Front. With the great increase in size of explosive charges used in craters and in camouflets, following upon the increased depth of mines, the more extensive mine systems, and the consequent increased personnel employed, the casualties from gas poisoning assumed serious proportions.

By far the greatest number of gas poisoning cases in mining were caused by carbon monoxide. As this gas is not naturally present in the soil, it could only result from the explosives used.

Gases from the detonation of a high explosive include carbon monoxide, hydrogen, and methane, all of which are combustible, and, when present in the proper proportion, explosive. Methane is never formed at the time of explosion, but results from the action of hydrogen on the oxides of carbon as the gas cools down, which it quickly does in the galleries. The greater the amount of hydrogen formed, the greater will be the proportion of methane.

When explosive gases are ignited, they do not explode at the point of ignition, but at a certain distance away. One grave danger from explosions of gas is the rapid flooding of the mine system by gas from the camouflet, owing to the combustion and explosion of the gas in the galleries causing a partial vacuum, so that the majority of the casualties from explosions of gas were due to carbon monoxide poisoning.

Attention was first directed to gas explosions by a serious one which occurred in January, 1916, when a tunnelling company suffered considerable casualties, the officer commanding, another officer, and 16 other ranks being killed.

MINE RESCUE APPARATUS

The Proto apparatus was the one chosen, as I considered it the simplest and most efficient rescue apparatus on the market. For scouting, and work which did not necessitate more than half an hour in the mine, the Salvus apparatus was used. In deciding on an oxygen resuscitating apparatus, it was necessary to remember the class of men who were to carry out first-aid; therefore it should be of the simplest type and foolproof. Automatic resuscitating apparatus, the best known of which is the Pulmotor, was rejected as being too heavy and complicated for use in the trenches, besides being dangerous even in the hands of medical men. The Novita apparatus was fixed upon, and modified to meet the conditions of military mining, being coupled up in a box ready for immediate use. The box and handles were arranged in such a way that it was easily carried down the shaft.

In the early days of mining, life-lines were used for hoisting men up the shaft. The difficulties and dangers of this method of bringing up an unconsciousness man, the constriction of the chest wall, and the serious effect this must have in certain cases, the danger of the rope slipping, and also the great exertion entailed in hauling a man along the galleries, showed the necessity of obtaining a stretcher which would be useful in the gallery and in bringing men to the surface. In a few weeks a mine stretcher, designed by Lieut. Penman, R. E., one of the officers in charge of mine rescue schools, was in use.

Mine rescue schools for the training of rescue men were started in each army. The officers in charge of these had skilled knowledge of rescue apparatus and rescue work in coal mines, and, in addition, they had the great advantage of having been previously engaged in actual mining in the trenches. From the beginning it was insisted that the training in wearing apparatus should be very searching in character, approximately as nearly as possible the work rescue men are called on to do in the trenches. The training in the schools included working at the face, either in clay or in chalk, driving and timbering galleries, recovery and disposal of the spoil, walking quickly, climbing vertical ladders, walking up inclines, and recovering a good solid substantial dummy from under *débris,* placing it on the mine stretcher, and bringing it to the surface. It was only by strenuous training that the men were given the necessary confidence in the apparatus, which is all-important in rescue work, and permitted them to face the most trying and difficult conditions. Not only must the men be accustomed to wear the apparatus, but they must have a thorough knowledge of every part of the apparatus and its uses.

In companies efficiency in rescue work was maintained by weekly practices. The only possible way of getting good results from first-aid in the trenches is to have a rigid line of treatment, and that all should have a thorough working knowledge of administration of oxygen, and how to perform artificial respiration. Schaefer's method was the one fixed upon as the simplest, and it was the only one taught.

Mine rescue stations, in which rescue apparatus and material were stored, were organized in dug outs in close proximity to all mines. When convenient, one station served a group of mines, but when possible they were never placed more

*Abstract of Paper before Institution of Mining Engineers.

than 250 yds. away from any mine shaft. In certain cases it was found necessary to keep apparatus ready for immediate use at the shaft head. When this was done, it was kept in the cupboards specially designed for the purpose. Two trained rescue men were in constant duty at these stations. These men had a thorough knowledge of the position of each mine served by their stations, and were familiar with the various workings.

RESCUE WORK IN THE TRENCHES

In rescue work in the trenches, the necessity of not wasting time in recovering the dead until all chance of saving others had gone was insisted on; also that the object of rescue work is not only to save life but to prevent further accidents; consequently obedience to standing orders must always be most carefully observed. The mine rescue men were frequently called upon to deal with fires in dug outs, and their work proved of the greatest value, saving a considerable numbers of lives and much valuable material.

In the rescue stations asbestos hoods and coverings for the Proto apparatus, so as to give protection against heat, were stored. Fires in mines were rarely encountered.

SAFETY RULES FOR OXY-ACETYLENE WELDING

The Western Pennsylvania Division of the National Safety Council has been making a study of both safe and unsafe practices in the care and operation of welding equipment now so widely employed. The following rules have been formulated for the guidance of those who use the oxy-acetylene torch, or who transport or care for the gas holders:

OXY-ACETYLENE EQUIPMENT

1. All pressure tanks should be fitted with safety relief devices, and tanks not so equipped should not be used.

2. The equipment should include a high-pressure gage to indicate the pressure on the tank, a reducing valve, and a low-pressure gage to indicate the pressure on the torch. These should be assembled as one unit and so arranged that they need not be separated when they are attached to, or detached from, the tank. The two gages should have different-sized openings; one should have a right-hand thread and the other a left-hand thread so that they cannot be interchanged. There should be one of these units for the oxygen tank and one for the acetylene tank.

3. All pressure regulators should be equipped with a safety relief valve which will relieve the pressure from the diaphragm and low-pressure gate in case the high pressure valve should develop a leak.

4. Wire-wrapped hose should not be used.

5. The oxygen and acetylene hose should be of different color or the couplings should be stamped for identification purposes, so as to avoid inter-changing the hose.

6. The torches should be of a type which will not backfire.

RULES FOR OPERATION

1. Under no condition should acetylene be used where the pressure is greater than fifteen pounds per square inch.

2. Special care should be given to the storage of oxygen and acetylene tanks. Acetylene is classed as an explosive, and only a limited number of containers should be stored in any one place. Oxygen tanks should be stored in a separate place from acetylene tanks.

3. Oxygen and acetylene tanks should not be allowed to remain near stoves, furnaces, steam heaters or other sources of heat, and should not be exposed unnecessarily to the direct rays of the sun, as an increase in the temperature of the gas will cause a corresponding increase in the pressure within the tank. Any excess of heat may also soften the fusible safety disk with which the tank is provided, causing it to blow out and permitting gas to escape.

4. Oxygen tanks should never be handled on the same platform with oil or grease which might find their way into the valves on the tanks.

5. Oxygen and acetylene tanks should never be dropped nor handled roughly and should never be stood on end unless fastened so as to prevent them from falling over.

6. Tanks should not be handled by crane, either magnetic or mechanical.

7. All empty tanks should be marked plainly with the word "empty" and returned promptly to the store room.

8. An open flame should never be used for the purpose of discovering leaks in acetylene tanks. Leaks can generally be detected by the odor of the acetylene gas, and their location can be determined by applying soapy water to the surface of the tank and watching for the soapy bubbles formed by the escaping gas.

REPAIRS TO EQUIPMENT

9. No repairs to oxygen or acetylene tanks or equipment should be made or attempted. All defects should be reported promptly to the foreman, and by him to the manufacturer.

10. Leaking acetylene tanks should not be used, but should be placed in the open air and all open lights kept away from them. All leaking acetylene tanks should be reported promptly to the foreman and immediately returned to the manufacturer.

11. All open flames should be kept away from

any place where there is any possibility of acetylene escaping.

12. Care should be taken to protect the discharge valves of tanks from being bumped, as a jar may damage the valve and cause it to leak.

13. Grease in contact with oxygen under pressure may cause spontaneous ignition. Great care should be taken not to handle threads or valves with oily hands or gloves, and gages should not be tested with oil or any other hazardous carbon. If a lubricant must be used, the purest glycerine is permissible.

14. Gages, apparatus, and torches requiring repairs should be sent to the manufacturer, and local repairs should not be attempted. Valve seats should never be replaced except by the manufacturer.

USE OF PRESSURE REGULATOR

15. The use and operation of the pressure regulator or reducing valve on oxygen or acetylene tanks should be as follows:

a. Open the discharge valve on the tank slightly for a moment and then close it. This is to blow out of the valve any dust or dirt that might otherwise enter the regulator.

b. By means of the stud or nut connection on the regulator, connect the regulator to the discharge opening of the tank.

c. Release the pressure adjusting screw of the regulator to its limit.

d. Open the needle valve slightly if there is one.

e. Open the discharge valve on the tank gradually to its full width.

f. Open the needle valve to its maximum, if there is one.

g. Adjust the pressure regulating screw until the desired pressure is shown on the low-pressure gage.

16. The discharge valves on the tanks should be opened slowly, and care should be taken to avoid straining or damaging them by the use of a hammer or the wrong kind of wrench. A special wrench should be made for use in opening these valves in case they stick.

17. When the operation of the cutting or welding torch is stopped for a short time, the needle valve on the regulator should be closed, or the pressure-adjusting screw should be released to keep the pressure off the hose. The torches should be opened momentarily to let the pressure out of the hose lines.

18. All tanks should be inspected at the close of the day's work.

19. Proper precautions should be taken to protect the hose from flying sparks.

HOSE AND JOINTS

20. All hose should be examined periodically at least once every week. This should be done by cutting the hose off at the end of the connection and examining it. In addition, after a few months' use, the hose should be cut off about two inches back of the connection and examined for defects. A defective hose should never be used.

21. Special care should be taken to avoid the interchange of oxygen and acetylene hose or piping, as this might result in a mixture of these gases that would be highly explosive. The practice of using right and left hand threads is recommended.

22. White lead, grease, or other similar substances should never be used for making tight joints. All joints and leaks in equipment should be made tight by soldering or brazing.

23. The oxygen and acetylene valves at the base of the torch should be tested daily for leaks.

24. Where hydrogen or other gas is used instead of acetylene, the same precautions should be observed as for acetylene.

25. A fire extinguisher should be carried as regular equipment to be used in case of fire.

26. Men using welding apparatus should wear suitable welding goggles for eye protection, having frames that are non-conductors of heat (not celluloid), side shields to protect against hot particles of metal, and lenses of proper color.

27. Operator's clothing should be fire proof.

28. If valves become frozen, they should be thawed by hot water, not by flame or hot metal rod.

THE LATEST OF THE GREAT AQUEDUCTS

When the size and resources of the city are considered, Winnipeg, Manitoba, may fairly boast of its recently completed aqueduct as a far greater financial and engineering achievement than the Catskill water system for the world's metropolis. Detailed particulars of the work we find in a recent issue of *Fire and Water Engineering,* and the account is well worth reading.

A concrete conduit, eight feet in diameter, ninety-six miles long, and costing more than $15,000,000 has just been completed and the water has been turned into the city mains. The aqueduct has been pronounced one of the world's major engineering feats. It is in its way a victory memorial. It was begun in 1914 and built in the four years of war. It is said that only four cities in the world have gone further for their water. The aqueduct brings 85,000,000 gallons

every twenty-four hours from Shoal Lake, an arm of the Lake of the Woods, southeast of Winnipeg. Shoal Lake has an area of 107 square miles. The Lake of the Woods has an area of 1,500 square miles. The lakes are 300 feet above the level of the city and the flow of water is sustained by gravity.

The conduit tunnels under. the Red River, Whitemouth River and several smaller streams. It passes twenty feet beneath the bed of Red River through solid limestone. The length of river siphons and pressure sections is seven miles. Winnipeg in its early history, obtained its water from Red River. Fifteen years ago after several typhoid epidemics, a system of artesian wells was established. But while excellent for drinking, the artesian water was so hard it ruined boilers, water tanks and city mains and had to be chemically softened for household purposes. The new supply of soft water will save the citizens annually $1,161,000 in chemical softening plants; $500,000 in scale and corrosion in pipes; $58,000 in cisterns and tanks; ; $41,000 in boilers; and $27,600 in hot water heaters, to say nothing of the reduction in the yearly bills for soaps and laundry work.

To build the aqueduct, the city constructed its own standard-gauge railway and a telegraph line. The road is 110 miles long and its locomotives and 115 cars are valued $1,439,522. Several thriving towns sprang up along the steel and farmers began to settle in the country which was before a wilderness. The road will not be maintained in regular operation. The city also operated its own gravel pits, rock quarries and cement plants.

MAN FOOD AND PLANT FOOD

A noted German scientist over twenty years ago was a prophet with a chemical bent of mind who figured out a great truth. He said that Europe would face a soil exhaustion unless it took steps to stop it, and Germany in particular. He pointed out that an enormous advantage would be gained by importing raw materials and food stuffs which are rich in plant food and by exporting finished products and manufactured articles, chemicals, toys and products of the soil which contain little or no plant food, a balance would be struck.

And then he made the startling announcement that sugar made from beets was the finest thing to export. The beets themselves required excellent soil, but the sugar, the refined product composed of oxygen, hydrogen and carbon, did not have any chemical value as plant food. When the pulp and the leaves were returned as manure the soil would never be depleted.

The theory advanced in the preceding paragraph was the thesis of a scientist at the University of Gottingen and the creed that he formulated was this: "In every million bushels of wheat we purchase from America there are 1,575,000 pounds of plant food, nitrogen, phosphoric acid, potash which is worth 25 per cent. of the price of the whole wheat. In 20,000,000 pounds of sugar that we sell to pay for this wheat, there is not one "pfennig" worth of plant food.

The government is, therefore, justified in paying a bounty on all sugar exported because in fostering and increasing the sugar industry more than one purpose is accomplished. Not only are the agricultural resources of Germany built up and the development of the beet sugar industry in the United States discouraged and prevented, but when the time comes when Germany will be compelled to produce her own breadstuffs our rich sugar-beet fields will be ready."

COMPRESSED AIR HELMETS

The following question and answer we find in *Fire and Water Engineering.* The answer seems to be practically indisputable:

To the Editor:

In spite of all the talk about army masks and self-contained breathing apparatus, is not the compressed air helmet the most common-sense and efficient one of all? Surely the helmet which furnishes air as it it to be found in nature is the most sensible. In your discussions why do you not say something about the compressed air helmet?

Respectfully yours,

G. M. S.

South Bend., Ind.

Answer: The less said about the compressed or liquid air helmet the better. Some attempts have indeed been made to utilize liquid air and compressed air in helmets. In ordinary breathing, however, a man inhales and expires anywhere from 6 to 7 liters of air per minute during rest, up to 60 or 70 during vigorous physical exertion. It appears utterly impossible, on account of the weight of the air and necessary containers, for a man to carry with him either in compressed or liquid form such a supply as will enable him to have entirely fresh air at each breath for any such length of time as breathing apparatus is worn in fire service. For service up to a maximum of 10 minutes a compressed air apparatus could probably be devised and might be serviceable, although it would probably be rather heavy and expensive.

LUBRICATING AMMONIA COMPRESSORS*

To perform its functions properly, a lubricating oil should have body sufficient to keep bearing surfaces apart; should reduce friction to a minimum; should remain fluid at the lowest temperatures to be met in service; should not decompose and form deposits that will gum up the machinery; should have no ingredients which can corrode or pit metal, and should have flash point high enough to insure against the presence of volatile constituents.

To avoid vaporizing too quickly under the high compression heat in an ammonia compressor cylinder, a lubricant must have a good flash, say, 325 deg. F., and as some oil in vapor form is likely to be carried into condenser pipes with the ammonia gas, the cold test should be low enough so that the lubricant will not solidify in the piping and coils —5 to 10 deg. F. If it is carried on through with the liquid ammonia, it can be taken out by an oil trap, placed ahead of the liquid receiver and at the lowest point in the expansion and condenser coils. Such a trap may be made of a piece of 4-in. piping, 2 ft. long, with a draw-off connection at the bottom.

If the lubricating oil gets into the condenser coils and stays there, it can be loosened by cutting off the water from one stand at a time, allowing the coil to became hot, so that the oil is thinned and will run off into the oil trap.

Oil carried over, and collecting in the condenser and expansion coils, is a source of lost capacity, and is frequently due to locating the oil separator too close to the compressor discharge, where the gasses are hot and the oil mostly in vapor form. Placing the separator near the condenser gives time for the gases to cool somewhat before reaching it, so that the oil is partly condensed and is more readily separated.

All oil used for the compressor cylinder should be measured and a record kept. Any unusual increase in the amount fed should lead to an immediate investigation to prevent filling of the system.

As hot ammonia gas has a bad effect on stuffing box packing, a liberal supply of oil should be applied to the piston rod in the stuffing box to reduce the chance for overheating.

Discoloration in the ice is not always due to oil. Two cases were mentioned in the discussion, one where firebrick was used to fill an open heater in which there were no flow pans, and the mineral matter from the brick carried over into the ice; the other where rust from a fore cooler caused the trouble, which was remedied by painting the inside of the fore cooler.

**Paper and discussion, Nat. Ass'n. Prac. Refrig. Engrs.*

SOME CONDENSED ADVICE ON COMPRESSOR LUBRICATION

Explosions in air compressors and receivers occur with sufficient frequency to demand careful attention. The majority of such explosions are undoubtedly due, either directly or indirectly, to the lubricating oil used in the air cylinders. Poor working conditions of the compressor, such as leaking valves, hot and dirty inlet air, insufficient cooling water, carbon deposit in cylinder or connections, and high speeds of poorly designed compressors, all assist in producing dangerously high temperatures of the compressed air. These high temperatures are sufficient to ignite the volatile constituents of the lubricating oil, and produce violent explosions.

The Massachusetts Boiler Board recommends the following rules:

(*a*) Keep the temperature of the compressed air, during compression, as low as possible.

(*b*) Keep the piston and valves tight, and in good working condition.

(*c*) Take the inlet air from as cool and clean location as practicable.

(*d*) Use plenty of cold water, from a source which is not liable to fail, and have it visible at discharge from cylinders or coolers,

(*e*) Do not use kerosene or other volatile substances in the cylinder, tanks or any connections.

(*f*) Use mechanical or sight feed oilers for the compressor cylinder.

(*g*) Use the least amount practicable of the best air cylinder oil. Air cylinders require much less oil than steam cylinders.

(*h*) Keep the cylinder, tanks and connections as free from carbon, accumulated oil and deposits as practicable.

(*i*) A good cylinder oil is one which lubricates well, leaves little or no deposit, is the least volatile at high temperatures, and has a high flash point.

MINE EXPLOSION SUGGESTIONS

It is likely when an explosion occurs in a mine that the cage, signaling devices, headframe tower, or derrick may have been wrecked or disabled, observes *Rescue and Recovery Operations in Mines*. Immediate preparations should be made to descend the shaft. To determine whether men are alive at the bottom, signals should be given by pounding on any pipes extending down shafts. Lack of response may be due to the pipes being broken. To make sure, get a ¼-in. rope, fasten to its end a lighted electric hand or flash lamp, a lighted safety lamp and a small cage containing a canary bird, and lower them to the bottom of each shaft. If men are alive at the bottom they may see the lights and give some signal

or attach a message. The lower end of the rope should remain down five minutes, it should then be withdrawn, and the safety lamp and the canary examined. If the safety lamp is still lighted, and the canary alive or not disabled, men may safely descend the shaft, provided no change of ventilation in the meantime would cause the air in the shaft to change from still or intake to an upcase current. The return of the lighted safety lamp and the live canary will indicate that the oxygen content of the air is more than 17 per cent. (pure air contains about 21 per cent.) and that the carbon monoxide content, if any, is less than 0.20 per cent.

MINE-DUST SAMPLING

Tests are being conducted at the Pittsburgh station of the Bureau of Mines on the sugar-tube method of collecting dust samples from the air of metal mines, a modification of that used by Edwin Higgins in sampling dust in mines of the Joplin district. Preliminary experiments have shown that the old type of sugar tube had an extremely high resistance to breathing, amounting to from 15 to 20 in. at 16 liters per minute. This large resistance renders it impossible for a man to take a sample of appreciable size. As a result of experiments made with different dimensions of tubes, a size was found in which the resistance is reduced to only 3 in. of water at 32 liters per minute, and which is decidedly more efficient in removing fine dust.

On applying the standard tobacco-smoke test, it was found that the efficiency of the old type of sugar tubes was only 50 per cent. That of the new type will probably be about 90 per cent. Optical methods are used for determining the efficiency, and by such methods very fine particles can be distinguished—much finer than by any other method.

WESTINGHOUSE SCHOLARSHIPS

As a proper war memorial to the more than 8,000 employes of the Westinghouse Electric & Mfg. Co. who entered the service of the Government in the war, the company has decided to establish four technical scholarships each year under the following general conditions:

Candidates will be limited to sons of employes of the Westinghouse Electric & Mfg. Co. and its subsidiaries, who shall have been employes in good standing for a period of five years.

Two of such annual scholarships may be open to the younger employes of the company or its subsidiaries who have been in their service for a period of at least two years and who do not exceed the age of twenty-three.

The selection is to be determined by competitive examination to be conducted annually by the company's educational department, which will take into account not only the applicant's academic training and preparedness, but also personal qualifications, general character, and aptitude.

Scholarships will entitle the successful candidate to pursue a four year's course in any technical school or college that he may select with the approval of the committee. The scholar may pursue a course in any branch of engineering that he may select.

Scholarships will be granted for one year only, but will be continued for the full four years provided the scholar maintains the academic and other standards required by the college or institution in which he elects to pursue his course of study.

Each scholarship carries with it an annual payment of $500, to be made in two installments.

In a paper on "Powdered Fuel," read before the Sheffield Society of Engineers recently, Mr. J. S. Atkinson gave the following advantages for the system as regards control:—Positive control is obtainable as regards the amount of fuel burnt, the working temperature and the nature of the flame, oxidising, neutral or reducing. The control of the nature of the flame is very important in many cases, as, for example, in puddling; also, as it is possible to maintain a neutral or slightly reducing atmosphere in a furnace, scaling or slagging losses can be brought down to a minimum. Such savings in scaling often show more important total savings in the cost of production than even large economies in fuel.

In order that engineers and mechanics trained by the State shall, upon discharge from the Army, receive the positions for which they are fit, the University of California Alumni Association has established a Bureau of Occupations. The secretary is Homer Havermale, and his address is 201 California Hall, Berkeley.

In Ohio a new law forces gas companies and other public utilities to get permission of the State Utility Commission before discontinuing service. Now if a law were enacted that would force wells to yield ample quantities of gas, Ohio's fuel troubles would be less poignant.

Col. Douglas I. McKay has been elected president of the Pulverized Fuel Equipment Corporation, 30 Church street, New York, to succeed John E. Muhlfeld, who retires to return to consulting engineering practice.

MINING ACCIDENTS

The following is a brief abstract of an address by Albert H. Fay, U. S. Bureau of Mines, before the Mine Safety Conference at Duluth, June 20:

Mining is one of the extra-hazardous industries, employing more than 1,000,000 men in the United States of whom three or more out of every 1,000 men employed are killed each year by reason of some accident. While complete data relating to non-fatal injuries are not available, yet reports to the Bureau of Mines for all metal mines in the United States, show that at least 250 men per 1,000 per year are injured sufficiently to cause a loss of time. Approximately the same rate will apply to other branches of the mining industry.

In all industries there are a certain number of accidents that are inherent, for which it is impossible to place the blame on any one. These equal about 50% in the mining industry. The responsibility for the remainder may be placed about equally on the operator and the employee.

The campaign of education for employees in the various industries has also been extended to the mining industry to the extent that many of the larger operators are making special efforts to educate their workmen in various ways. So far as accidents are concerned probably the principal thing that can be done along educational lines is to see that the employees are thoroughly instructed in the English language, and as to the dangers which they encounter when they enter the mine, and to furnish them, through their superintendents and shift-bosses, instructions as to how to avoid accidents and to take care of themselves. Much of this educational work may be done through safety committees, consisting in part of members from the various occupations in and about the mines, giving the miner an opportunity to make suggestions that he considers will prevent accidents in his particular working place. Many of the companies have these committees actively at work, and they are meeting with gratifying results.

BEESWAX SAVES MINE PUMPS

The rapidly destructive corrosive effect of acid water in mines is frequently quite astonishing. Pumps have sometimes been rendered absolutely useless in two or three days. Harry Goodman tells in a recent issue of Coal Age how a simple, cheap and efficient method of protecting mine pumps from the corrosive action of some particularly bad mine water was recently tried out successfully at Herrin, Ill. After five pumps had been put on the scrap pile one after the other, Elmer Mayor, the top boss, conceived the idea of using beeswax on the parts of the pump exposed to the action of the water. Accordingly, he took apart a new pump, carefully wiped off all grease and dirt from the faces and even from the bolts that clamped the parts together. After carefully heating the clean surfaces he applied the melted beeswax to form an even, thin coating and bolted all the parts together with similarly treated bolts. The pump was then installed and has run without any further attention except the regular oiling. Before the beeswax was tried the pumps lasted from one to three days. The treated pump has been running for several months.

GUNPOWDER IN THE MACHINE SHOP

In the Delaware & Hudson R. R. shops, Watervliet, N. Y., according to *Du Pont News Service,* they are using ordinary black sporting powder for various operations such as: Blowing nuts and bolts and rivet heads, breaking up iron and steel to be scrapped, forcing a piston off when rusted fast, breaking metal that has become cold in a furnace.

The charge of powder is loaded in steel guns varying in size from end to end from 5 to 12 inches with other dimensions in proportion, and held by a steel plunger, which is forced out when the charge is set off. No wad is used. The plunger is milled to a size to fit the bore of the gun. Some of the gun-barrels are milled in the shape of an octagonal prism, instead of being cylindrical, the bore, of course, in all cases being round. The gun after having been loaded is jacked up with the mouth within about one inch of the object to be struck by the plunger and fired. An average of one ounce of powder is used for each nut or bolt (sizes in common use on locomotives) that is to be broken off or loosened. The load, of course, is varied with the work to be done. By the use of these guns, it is claimed much time and labor can be saved and that a quick blow can be directed at an object that is barely reachable otherwise.

A COMPRESSOR DETERMINED TO WORK

The following bona fide letter, reproduced practically verbatim, tells its own story with admirable completeness. It is addressed to the Ingersoll-Rand Company by the Oregonian Publishing Company, Portland, Oregon.

Some time in August, 1904, we ordered an air compressor from you through your then representative here. The machine, a Class E, 8 by 8 in., motor and chain driven, was installed in our plant in the early part of 1905.

This machine was put in on our air load, supposedly to run with an intermittent control—

which it did very nicely for about six months—when the service began to become a close succession of intermittent cycles just about continuous for twenty-four hours a day.

Last week, after about eleven years of wind-jamming, up to eighty pounds most of the time, our poor old Ingersoll began to show signs of wanting to drive the motor every time it stopped. It seemed to be developing an unusual amount of "pep" for an old sport—sort of coming back in its old age—did not want to stop when the motor did.

We decided that the old boy must be in distress in some way, so we took out the valves and found that they were actually worn out. So now we come to you for some new valves. Sorry we have to do this; and we are also afraid that the new valves, some way, will not be as good as the old ones, but we will have to take a chance.

We wore out the control furnished originally with the compressor; we have worn out several chain drives, and some armatures on the motor—but the old Ingersoll compressor has been our friend day and night—through thick and thin—and, gentlemen, we sure appreciate the service you have rendered us in slipping us this machine. If you ever have any skeptical prospects in this Northwest territory who seem to hesitate about buying your apparatus, just send them around and we will convince them.

Enclosed please find requisition covering order, which we trust you can ship in the near future, as we do not want that old sport to overdo, in trying to run that motor as a generator.

NEW AMERICAN EXPORT RECORDS

A remarkable increase in exports during June brought th total for the fiscal year 1919 to more than seven billion dollars, a new record, according to a statement issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce. The June exports were $918,000,000, which exceeded the previous high record, established in April of this year, by more than $200,000,000. The exports for June of last year were valued at $484,000,000. Total exports for the fiscal year stand at $7,225,000,000; as compared with $5,920,000,000 for the fiscal year 1918. This is more than three times the exports for 1914, the last normal year.

Exports since the armistice was signed in November are estimated at about $5,000,000,000. The excess of exports over imports for the fiscal year 1919 was $4,129,000,000 against $3,000,000,000 the previous year and less than $500,000 in 1914.

The removal of wartime restrictions caused a decided increase in the exports of gold. from less than $2,000,000 each in April and May to $83,000,000 in June. Gold exports for the fiscal year amounted to $117,000,000, against $191,000,000 for 1918. Exports of silver fell off from $29,000,000 in May to $13,000,000 in June, but increased from $139,000,000 for the fiscal year 1918, to $301,000,000 for 1919.

DIESEL ENGINE AND SEMI-DIESEL ENGINE PRECISELY DEFINED

A Diesel engine is a prime mover actuated by the gases resulting from the combustion of a liquid or pulverized fuel injected in a fine state of sub-division into the engine cylinder at or about the conclusion of a compression stroke. The heat generated by the compression to a high temperature of air within the cylinder is the sole means of igniting the charge. The combustion of the charge proceeds at, or approximately at, constant pressure.

A semi-Diesel engine is a prime mover actuated by the gases resulting from the combustion of a hydro-carbon oil. A charge of oil is injected in the form of a spray into a combustion space open to the cylinder of the engine at or about the time of maximum compression in the cylinder. The heat derived from an uncooled portion of the combustion chamber, together with the heat generated by the compression of air to a moderate temperature, ignites the charge. The combustion of the charge takes place at, or approximately at, constant volume.

INFLAMMABILITY OF ALUMINUM DUST

As prepared, the aluminum dust of commerce is finely divided aluminum metal with a coating of oil, usually stearine or some similar material. This coating evidently serves to prevent oxidation in air and to protect the metal particles from the action of moisture, as it is stated that the product loses its lustre if no oil be added. Aluminum dust is so light that it is easily blown about a room, and as the workmen seldom take precautions to prevent this the workrooms are soon coated with the dust.

Evidently all apparatus should be inclosed to prevent loose powder from being blown into the air. Although experiments do not show the exact conditions under which an ignition of the aluminum dust is obtained they do show that it may ignite at temperatures even lower than those necessary for the ignition of 200-mesh standard Pittsburgh coal dust; also more heat is needed to ignite aluminum dust. The dust used in the tests was a commercial product labelled "aluminum bronze."—*Technical Paper 152, U. S. Bureau of Mines.*

THE SKY PATROL FOR FOREST FIRES

The government has converted part of the war-time air fleet into a national forest patrol, with dirigibles, scout planes, flame extinguishing bombs and sky-riding firemen to save the billions of feet of timber annually destroyed by forest fires. The experiment is being launched in the Cleveland and Angeles national reserves in California, the U. S. Forestry service and the army working together. Successful there, it will be extended to the other 145 reservations throughout the country as fast as districts can be organized.

Under this system, fire fighters will be rushed to incipient blazes it formerly took hours to reach. Bombing planes will smother small fires. Trained fire-fighters will be lowered by rope ladders from anchored dirigibles. And balloon sentries, in communication with forest posts by wireless, will hang over danger areas. The first of these sentries is on the job at Arcadia, Cal. Daily he soars to his 3,000-foot-high post. Then at ten each morning, two planes leave March Field, near Riverside, following routes from which the heavy forest can be scanned for over one hundred miles.

A second patrol covers the district in the afternoon. In these planes the observers carry maps on which the forest is ruled off in squares, keyed by plainly visible landmarks and villages. A discovered blaze is immediately marked in the corresponding square on the map. The machine pilot then swoops low over the nearest village, drops a parachute message asking the finder immediately to phone the information to the district supervisor, or goes back to report personally.

All residents have been informed about these messages and how to co-operate. Meantime, the dirigible at Arcadia remains aloft throughout the day, in wireless touch with ground stations where trucks suitable for hard mountain travel stand ready for instant use and a squad of ten enlisted men is prepared to rush into the forest with extinguishers, axes, picks, tanks of water and canteens.

A UNIQUE MINE RECORD

The deepest metal mine in the world, a gold mine, and one of great age as mines go, is the St. John Del Rey in the state of Minas Geraes, Brazil. *The Mining and Scientific Press,* San Francisco, brings together the following data from its latest, the 88th, annual report, the enterprise being British.

Last year the output of gold was worth £423,-029, or about $2,000,000 in American money. Th average yield from 165,000 tons was $13.27. The profit was $590,244, which was $90,000 less than in 1917, the decrease being due chiefly to the adverse conditions created by the War. A dividend of 10% was paid for the year 1918. The workings have reached a vertical depth of 6326 feet. At the bottom the temperature is 116°F. when the ground is first penetrated, and even the mean temperature of the air underground during the summer is close to 100°, so that particular pains has to be taken to ventilate the mine with a view to rendering working conditions tolerable. The natural increase of temperature is one degree per 126 feet of descent.

A large Sirocco fan is used and it is proposed to supplement this with an air-cooling plant. The deeper portion of the mine, below 1,940 ft., has been opened up in a most unusual way, by means of a steplike system of winzes and levels, each winze being 1200 feet long and connected with four levels at intervals of 300 feet, so that, as a Cornishman would say, "the h'ore is pulled out by the 'air of the 'ead." The scheme of development depends upon the fact that the workings follow not the dip of the lode but the pitch of the orebody, which stands at an angle of 40°. It is pleasing to note that the size of the orebody and the quality of the ore have shown improvement on the lowest 'horizons,' as they are called, although the showing is not so good as it was in the younger days of the mine, the dimensions of the orebody at 5800 feet being about 15 feet by 1,000 feet, as against a width of 45 feet and a length of 600 feet in the upper workings. The reserve of ore amounts to 1,209,104 tons.

GEOLOGY AT A GLANCE

PROMOTERS and reporters play the very devil with geology, exclaims the *Mining and Scientific Press.* For instance, we read in one of our local papers that the president of a mining company at Tonopah "reports everything in tip-top condition." No wonder, for "at present they are in a formation of anthracite and pophyry, which is the true foundation to make ore in the Tonopah district." We hasten to the help of a bewildered reader by suggesting the substitution of 'andesite' for 'anthracite;' but even that will not suffice to make sense, because the andesite is a 'porphyry,' that is, an igneous rock in which some mineral is so prominent structurally as to give it a speckled appearnce. In this same Nevadan prospect we are told that "they will soon cross-cut on the 200 and then some real developments are bound to be found." This is an excellent example of journalese, using the abstract instead of the concrete; we hope they will find some real ore, that is, 'pay-ore,' instead of anything so indefinite as 'developments.' One can find them without incurring the cost of mining.

Recognition of Roosevelt for Building Panama Canal

By DANIEL SULLIVAN

WHEN GENERAL GOETHALS received the John Fritz medal last May for his work in building the Panama Canal, he made it plain, in accepting the "distinguished service medal" of the engineering societies, that the Canal would never have been possible but for the unfailing aid and coöperation of another. That other was, of course, Theodore Roosevelt, and General Goethals very fittingly took occasion at this opportunity to remind his audience of the courage and steadfastness and foresight which Roosevelt exhibited in bringing to fruition one of the greatest engineering feats of all time.

It needed courage to hew through the very determined opposition to action in starting the Canal work which Roosevelt found facing him in his own country more than it did to meet the obstacle of non-consent that was raised by the so-called government of the Republic of Colombia. Courage was indubitably Roosevelt's characteristic, but never perhaps was his faculty for decision more positively illustrated than in his course in connection with the starting of the Canal.

In fact this decisiveness in the manner of his determination of the kind of canal to be built and the best place to build it is in many respects more remarkable than the swiftness with which he took action in coping with international difficulties that, as he himself said, threatened to result in another half century of conversations without any actual work being done to dig the Canal.

If not the greatest of his achievements, the building of the Panama Canal was one of the most important of Roosevelt's during his tenure of the Presidency. And it was peculiarly his achievement. Without his active interest, his courage and his daring it is certainly open to question whether instead of a permanently useful link between the oceans there would be today on the Isthmus of Panama more than the unsanitary ditch of the unfortunate de Lesseps. But Roosevelt's part in deciding the route and type of the Canal to be built, his keenness and foresight in going against the opinion of the majority of the engineers may well have been lost sight of, so long has the Canal been an accepted fact and so long has this great waterway been carrying the commerce of the world.

That the Panama Canal as a lasting benefit to the whole world is distinctively the work of Theodore Roosevelt it is well to remember in connection with the campaign of the Roosevelt Memorial Association which will be held throughout the country during the week of October 20-27. In this achievement alone he was chiefly instrumental in providing for the world a permanent material benefit, whose value is beyond computing; and, if for no other reason, here is a tangible work which makes incumbent upon patriotism and gratitude the most widespread and generous response to the appeal for funds for a fitting memorial.

A NEW SERIES OF ARTICLES ON MIDWESTERN INDUSTRIES

IN THIS issue of COMPRESSED AIR MAGAZINE begins the publication of a series of articles on various industries in which compressed air and pneumatic devices are largely employed. These articles are written by FRANCIS JUDSON TIETSORT, Managing Editor, who lately completed a trip through Middle Western and Northern States on behalf of this publication. He visited tire-making, automobile, chemical and steel plants. Mr. TIETSORT also spent considerable time on the copper and iron ranges of the Lake Superior country, having some unusual and highly interesting experiences both underground and on the surface at the mines in the Northern Peninsula of Michigan and in Northern Minnesota. These articles, which are to be illustrated, are prepared in popular vein and will be as interesting to the layman as to the engineer and production manager.

According to an estimate published by the National City Bank, New York, the capital investment for each worker employed in American manufacturing industries increased from $2,117 in 1904 to $2,848 in 1914. An estimate for 1919, based on increased cost of production and price of product, would probably place the figures at $4,000 or more.

A Nebraska farmer reports that he turned the exhaust of his tractor into a corn crib and killed a bushel of rats.

Labor leaders are asking Congress to appropriate millions for an employment service, and yet declare that we are facing a shortage of labor.

Notes of Industry

Carter Glass, Secretary of the Treasury, announces that because of the great popularity and extensive sales of war savings and thrift stamps, the government will establish the savings plan on a permanent basis. The net cash receipts of the U. S. Treasury as a result of stamp sales up to June 30 of this year amounted approximately to $956,000,000. The Government is waging a campaign against dealers who buy in war savings stamps and Liberty bonds. It is also calling attention to smooth stock salesmen for dubious, if not fictitious issues, and requests that persons approached by them inquire whether these gentry will guarantee one's money back with interest on ten days' notice. Of course they will not. The Government then points out that it will do just that for its small investors.

In the course of a lecture at the Royal Institution, Professor Bragg said it was important that we should have some means of knowing when a submarine was within a mile of the "hunting" ship. The question of listening under water had been much studied during the war. "The perfect system," declared the lecturer, "is more than on its way. The Admiralty practically has it in hand. It will be a great day for all of us when we can say, not as members of the League of Nations, 'You shall not build submarines,' but as members of a nation which can declare: 'You can build as many submarines as you like. They have lost all their terror for us.'"

According to a summary made by the United States Fuel Administration, figures show that the saving in fuel consumption alone in 1918 due to the daylight saving was 1,250,000 tons. In one city the people saved $60,000 in gas and much more in electricity; the average sized city saved from $30,000 to $40,000 in lighting and fuel cost.

Tables recently published by the Forest Service of the Department of griculture show a lumber production in 1918 of 32,760,000,000 feet as against 36 billion feet for 1917. Decrease in lumber production has been most marked in Southern and Eastern states.

The sudden ending of war demands left the New York Air Brake Co., with its plant extended for war work and a civilian demand for air brakes far below its increased capacity for production. To take up the slack the company is turning to the manufacture of trucks and talks also of tractors.

Officials of the Bureau of Standards are now conducting experiments for the purpose of determining the value of different mixtures of concrete made with the Brown atomizer. This apparatus consists of a rotary mixer and a device for blowing the mixed concrete through the hose. The hose is directed by the operator to the form or walls where the concrete is to be placed. Results show that concrete blown with hot air is superior to others, and the experiments will be continued during the coming months.

The coal producers are warning the public to buy coal supplies at once and prevent a coal famine next winter. "To be coal warned is to be coal warmed."

Fifty miles in 26 minutes, 23.2 seconds is the latest speed record reported in an automobile race. This record was made at Sheepshead Bay, New York City by Ralph De Palma. It is equal to 113.7 miles an hour.

According to the reports of French engineers who have investigated the mines flooded by the invading Huns, 30,000 hp. of pumping equipment will be required for two years to free the mines of water.

The manufacture of nitrates by the fixation of atmospheric nitrogen is rapidly becoming a world industry. In this the Japanese are keeping in line with American and European enterprise. D. Takamine has, it is said, purchased, on behalf of Japan, the American modification of the Haber process. It is intended to instal a plant to use this process for the production of synthetic ammonia. The Japanese Government has provided means for the building and maintenance, in a suburb of Tokio, of an experimental laboratory for research concerning the conditions of the fixation of nitrogen.

Acetic acid is being manufactured from cocoanut shells in Ceylon.

John Canton, a riveter at the Morse Dry Dock, South Brooklyn, together with his two helpers, has established a small crew record of 9,153 rivets in eight days, or an average of 1,144 rivets every eight hours. Victor Sobatino and his two helpers of the same plant, drove 5,760 rivets in six days, or an average of 960 for each eight hours. These are the kind of riveting records that count, as they are not spurts on a given day for which the stage is set, using six or eight men, but constitute continuous performance under normal conditions.

Personal Intelligence

The Submarine Boat Corporation doffs its hat to Mr. O. Briggs, of Newark, N. J., a joiner foreman on the company's Wet Dock, who has been employed eighteen months. Mr. Briggs is not only a hustler on the job, but has never lost a day, an hour, or a minute, has never clocked in late, nor clocked out ahead of time. His batting average of 1.000 is worthy of note in many other industrial plants.

* * * *

Maj. Charles B. Going was discharged on his return from France after eighteen months service. During his entire service he had done editorial work on the Ordnance Encyclopedia and on various histories of the Ordnance Department in the A. E. F. He is a graduate of Columbia University and before entering the service edited and managed the magazine and book publications of the Engineering Magazine Co. His permanent address is Salamagundi Club, New York City.

* * * *

The American Institute of Electrical Engineers elected Calvert Townley president at the recent annual business meeting held in New York City. Mr. Townley is assistant to the president of the Westinghouse Electric and Manufacturing Co. He was born Oct. 18, 1864, in Cincinnati, Ohio, and was graduated from the Sheffield Scientific School in 1886, afterward taking a mechanical engineer's degree in 1888. He has been connected with the New York, New Haven & Hartford R. R. as vice-president in charge of electrification out of New York, subsequently becoming first vice-president of the Consolidated Railway Co. (afterward the Connecticut Co.), president of the Lackawanna & Wyoming Valley R. R. Co., and vice-president of the Niagara, Lockport & Ontario Power Co.

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Lewis A. Belding, who for the last two years has been assistant professor of mechanical engineering at Stevens Institute of Technology, Hoboken, N. J., has become associated with the Thomas A. Edison interests at Orange, in the power service division, as service engineer.

* * * *

Homer L. Ferguson, president of the Newport News Shipbuilding and Drydock Company, is the new president of the Chamber of Commerce of the United States. He succeeds Harry A. Wheeler, who after serving as president of the Chamber during the first two years of its existence and again last year during the war emergency, declined re-election. Mr. Ferguson was elected by the board of directors of the Chamber on a vote taken by mail. His was the only name placed in nomination by a nominating committee which met immediately after the conclusion of the seventh annual meeting of the Chamber of St. Louis.

* * * *

Henry M. Robinson, Pasadena, Cal., has been appointed a member of the Shipping Board to replace Charles R. Page, of San Francisco. Walter S. Reed, treasurer, will succeed George T. Smith; P. J. McAuliffe will succeed Daniel Cox, head of ship construction division; R. E. Talbert will succeed M. D. Ferris, head of contract division; Capt. R. E. Bakenhus, United States Navy, will succeed Admiral H. H. Rousseau, head of the shipyard plants division; M. H. S. Rollason will succeed A. E. Pfeiffer, head of the material supplies department. No reports have been received as to the successors of Gordon Wilson, general auditor, and R. W. Leatherbee, head of the industrial relations division. S. M. Evans, Orange, N. J., will succeed Howard Coonley.

* * * *

Thomas W. Pangborn, president and treasurer of the Pangborn Corporation, Hagerstown, Md., has been appointed a member of the Maryland Readjustment Committee which will give aid and counsel in matters applying to manufacturing, finance and transportation. Mr. Pangborn will represent the western part of the State, serving with the following: Governor Emerson C. Harrington; William Ingle, president, Baltimore Dry Dock & Shipbuilding Co.; A. W. Thompson, vice-president, Baltimore & Ohio Railroad; A. C. Bruce, president, Bartlett-Hayward Company, and others, totaling fifteen.

* * * *

A. F. Hartigan, of Chicago, in laying a standard gage track to the site of a large industrial plant which was practically under water, built the track in sections, using cedar ties, and floated the track to place. The track was anchored to preserve the alignment. Cars loaded with sand were run out and the material dumped in ridges on which the workmen stood in working the filling material under the ties.

Something for nothing is pretty nearly realized by the different states which are to receive from the war department, free of charge, except for transportation, 20,000 surplus motor trucks of 2 to 5-ton capacity that cost more than $45,000,000 and are to be distributed by the war department for use in the construction of Federal Aid highways.

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BRINGING MISS COLUMBIA BACK TO HER SOBER SENSES

WHEN Mr. GEORGE HORACE LORIMER, editor of the *Saturday Evening Post,* wants his two million or more subscribers to absorb a certain salutary and wholesome idea, one like the following, for instance, he calls in an able writer who has a reputation for his work in fiction and explains about as follows:

"Mr. BLYTHE, (or Mr. GRAEVE, or Mr. COBB, or Mr. TURNER) there is getting to be too much frivolity, too much wasting of time and money, too much of a disposition to get much for little in this country. There is a tendency to regard idleness and unearned luxury as the great *desiderata* of life and we have got to do our share in stopping it. It is a dangerous, if not a fatal trend for any country. You will remember what happened to Rome. Study this situation and weave your findings into a novel which I wish you would do for me for publication in about six instalments."

The writer absorbs the idea, goes forth and gathers his materials and schemes out a narrative plot or structure, carrying out instructions much as a newspaper reporter would cover an important assignment for his city editor. The story is next written and illustrated and the editor's message is conveyed in the form of a candy-coated pill to millions of folk. The lesson or moral of the message are there in story guise.

* * * *

The foregoing may be considered as only an interesting incident of a campaign by editors, writers and government officials, by clergymen, educators, orators, and by thoughtful industrial production managers and other men of business in this country to bring the average citizen of the United States back to his senses. We have been getting up in the air and we must get our feet back on solid ground again. Incidentally we may well wish that there were more editors of the clear sanity of Mr. LORIMER, who feeling their responsibility, would remonstrate and warn against a pernicious and all too prevalent state of mind that seems to have fallen upon us as a reaction from the days of wartime anxiety and sacrifice.

The country is undergoing an orgie of extravagance. At prevailing high prices we are not even buying sane, sensible things of perminent usefulness, which would be justified if we might get our money's worth. Money that ought to go into new homes is being spent for

the costliest automobiles, bringing from $10,000 to $15,000 apiece. The jewelers report they cannot get enough of the costliest jewels to supply the demand. Women load themselves down with a queen's ransom in gems to outdo some other equally unwise woman. The example set causes folk of the middle class in worldly circumstances to become infected with the fever, and in turn those working for a weekly wage are seized with vaunting desires and dissatisfaction and demand high wages and short hours. Every boost in wages and every increase in the cost of materials is taken out of the ultimate consumer and the vicious circle continues on an upward spiral.

The old, and fallacious, excuse for buying something because it is cheap, assuredly has disappeared; nothing, or at least exceedingly little, that is desirable, is so cheap as to be a bargain these days. Yet people buy expensive luxuries without even inquiring the price. This presents a sore temptation to the retailer and it results in a condition that a degree of what we resignedly call the high cost of living is really the cost of high living. The office or shop girl wears silk stockings and dresses much as a lady of fashion, if not with the same richness of materials.

We saw a girl running a lathe in a machine shop recently, dressed in overalls, but she wore silk stockings and patent leather pumps.

A young Englishman, in New York for a few days on his first visit, en route for Brazil on business, was asked by us the usual question respecting how New York impressed him.

"It is a really wonderful and interesting place," he rejoined. "I am astonished by all I see, I admit. Everybody here seems so wealthy. And your women, including your typists and 'clarks' —my word—they are positively *duchesses.*"

* * * *

We sought to hire a colored maid. She asked for $3.50 a day, one day and a half "off" per week, and positively declined to do any real work.

There is unquestionably a serious trend in America that must be faced and kept within bounds. On the industrial side workmen are showing in some lines a tendency to skimp in their work, and production lags. There is a cry for shorter hours.

Now seven of the usual eight hours claimed by business is in all conscience an average light day's work. If production falls off, prices go up naturally, and production takes time. The argument is that shorter hours make for increased efficiency, but this has not been proved. If working men and women were all working at good speed or giving a fairly honest output for eight or ten hours a day, there might be ground for considering a six-hour day at commensurate pay, but what employer is prepared to say he could view the prospect with equanimity? Very few, we believe.

Work is the thing that keeps one young; it keeps one from becoming *blasé.* The reverse of a degree of honest, wholesome, creative employment, is idleness, with a resultant struggle to find pleasure. Amusement and relaxation find a legitimate place in the life of every well-balanced man or woman, but when pleasure is pursued to excess, for its own sake, it invariably results in satiety. When the saturation point of satiety is reached the tendency of the individual then is to follow the abnormal for the sake of new "sensations." The result is crime and disease. The fibre of the will, the instinct for the best in life, is lost to that individual.

Why does the successful man keep on working after he has accumulated more than he can spend on the needs of himself and family? One often hears this question, and the exclamation follows, "If I had as much money as Mr. Gotrocks I'd quit and spend the rest of my life having a good time."

The answer to the question is simple. The very qualities that made the active Mr. Gotrocks successful prohibit an idleness that would be repulsive to him. He has been able to buy enough and see enough of the pleasurable things of this world to know that if he gave up working and abandoned himself to pleasures that he would quickly become sated and die of *ennui.* We know a man in his thirties who has a fortune of $30,000,000. He has practically always had it, but he is one of the busiest men in lower Broadway as head of three or four large corporations. He takes an almost childish delight in his recreations when he has a chance to take them. If he were to

quit and liquidate his business enterprises he would throw 15,000 persons out of employment. As a producer he is making the world a better place in which to live, making others happy, or giving them a chance for happiness, through his industry, which enables them also to work and thrive.

* * * *

The best minds in both governmental and business circles are focussed on these problems, but each individual must consider them for himself and act as his conscience bids. We must stop cheating each other and cheating ourselves, for they are equivalents. No loyal, thinking American wants to see this mighty, well-loved land enervated. America must cling to her old wholesome ideas of industry. Her young sons who so lately have fought nobly overseas, and who have now returned, must come down out of the clouds. Her workmen must see that their interests and those of their employers are identical.

Let us dream of better things, by all means, but dream of honest achievements, for, as MARIE L. EGLINTON wrote:

Each dream that fires a mortal brain
Some day can be made true:
Whatever man can faintly hope
That can he strongly do.

Once, terrified, he scanned the skies,
And feared each stone, each tree;
But something in him watched and strove,
And led his spirit free.

Propitiate, but not with gifts,
The Powers of heaven and earth:
They and their friendly use are yours
By right of soul, of birth.

Dream, then, nor fear to dream too fair.
(Each seed is made to swell.)
If hand and brain are linked by faith,
God's realm is yours as well!

Dr. L. LEVINE recently quoted A. R. MARSH in an article in *The New York World* as saying that lowered factory and farm production constituted an important cause of high prices and that the crux of the problem was *the attitude of mind of working people which had resulted in a reduction of production.* Mr. MARSH had noted that in the cotton industry a large laboring force supplied with more machinery was producing less goods in 1919 than it had in 1916.

President WILSON in a late public statement declared:

"Only by keeping the cost of production on its present level, by increasing production and by rigid economy and saving on the part of the people can we hope for large decreases in the burdensome cost of living which now weights us down."

* * * *

In a recent article, STEPHEN LEACOCK, professor of political economy at McGill University, Montreal, declared to *New York Times* readers:

> The laborer will not work because the pay is too low and the hours are too long. The producer cannot employ him because the wage is too high and the hours are too short. If the wage is paid, and the short hours are granted, then the price of the thing made, so it seems, rises higher still. Even the high wages will not buy it. The process apparently moves in a circle with no cessation to it.
>
> * * * The public mind is confused. * * * To some minds the demand for law and order overwhelms all other thoughts. To others the fierce desire for social justice obliterates all fear of a general catastrophe. The "State," as we know it, threatens to dissolve into the labor unions, conventions, boards of conciliation and conferences. Society, shaken to its base, hurls itself into the industrial suicide of the general strike, refusing to feed itself, denying its own wants.
>
> * * * Never, then, was there a moment in which there was greater need for sane and serious thought. It is necessary to consider from the ground up the social organization in which we live and the means whereby it may be altered and expanded to meet the needs of the time to come. We must do this or perish. If we do not mend the machine, there are forces moving in the world that will break it.

Mr. LEACOCK comes to the conclusion, looking at it from the upper strata of life, that is, those who are in a degree comfortably situated, that the safety of the future lies in a progressive movement of social control, alleviating at least the misery it cannot obliterate, and based upon the broad general principle of equality of opportunity and a fair start. The chief immediate opportunities for social betterment, as this writer views them, lie in the attempt to give every human being in childhood adequate food, clothing, education, and opportunity.

The conviction is forced home on every hand that America must first look to its own welfare and make itself a leaven of sanity in a foreign world much worse off than are we.

* * * *

But let us think clearly. High prices, luxuries, leisure and fancied injustice, are only a part of our domestic troubles. We must realize that in

large degree the social unrest even in our own country, is due to foreign agitators who are poisoning the minds of our workmen; making them forget our free institutions; making them forget what the Grand Republic has accomplished since GEORGE WASHINGTON and his fellow statesmen welded the original colonies into what has become the world's mightiest nation. The Rev. Dr. NEWELL DWIGHT HILLIS, in an article in the September *McClure's,* which every level-headed American should read to absorb its every syllable, for it is one of the best expositions on the subject that has yet appeared in print, gives the answer to his question, "What is the Matter with the United States?"

Dr. HILLIS gives ample reasons why every workingman should be a red-blooded American, why he should squelch the sophistry of the imported agitator who has not absorbed or understood America, who knows little or nothing of the physical facts about it, who assumes that conditions here are the same as they were back home in Europe. For a fancied self-advantage, every workingman or woman, before turning his weapons against the institutions of this republic, this eminent Brooklyn thinker shows us, and before choosing between Lincoln and Lenine, should consider that this republic is the only country in the world that offers a man a reasonable chance of doubling his wage, and later of quadrupling his earnings.

We are in the world's best zone for producing foods, as half of the good agricultural land of the globe lies between Alaska and Cape Horn, and we are so situated that there is promise that our 110,000,000 people of today will, within the lifetime of children now living, become 400,000,000, and the present 250 billions of property of this country become a thousand billions. All civilization, its laws, liberty, art, science and invention, are rooted in farming land, and of the five continents ours alone enjoys ideal conditions for food production.

Another reason why our people should hesitate before deserting Americanism and accepting Bolshevism is that the average annual income of our working people is four times the annual income of the other peoples of the world. The population of the world, we are reminded, is sixteen hundred millions, and its total income in 1918 was two hundred billions of dollars, of which the people of the United States received fifty billions. While we are one-sixteenth of the world's population, we receive one-quarter of its total income. Today it pays to be a citizen of the United States, pays richly, in terms of wage and income alone. To reprint what recently appeared in these columns, although we are only six per cent. of the world's population, yet we produce:

75% of the world's supply of corn;
60% of the world's supply of cotton;
25% of the world's supply of wheat;
66% of the world's supply of oil;
60% of the world's supply of aluminum;
50% of the world's supply of zinc;
40% of the world's supply of lead;
60% of the world's supply of copper;
40% of the world's supply of silver;
52% of the world's supply of coal;
40% of the world's supply of iron and steel;
20% of the world's supply of gold;
85% of the world's supply of automobiles.

Before the war, Dr. HILLIS recalls, we owed the countries of Europe five billion dollars. We have paid the debt and foreign governments now owe us thirteen billions, while our gold reserves are the largest in the world. The political, financial and moral leadership of the United States of America are suggested by the simple fact that today twenty-five nations have given up autocracy or limited monarchy and become self-governing republics.

* * * *

While the wages of our working people have risen, the interest returns of the capitalists have fallen steadily. The time was when the rich were growing richer and the poor were getting poorer, but that day has passed from our country. In 1870 the interest rate in the west was 12%. Today it is 5%, even lower than the interst rates in rich New York. In a generation the interest rates have been halved. Meantime wages have mounted and everything tends to the diffusion of the good things of life for the average family.

Every human being in America has sixty slaves working for him in that our machinery equipment gives each person the results of sixty man-power, while the average person in the rest of the world has only ten man-power. Edison thinks

that soon every American will represent one hundred man-power.

The "trouble" with us, Dr. HILLIS finds, is not with our land, our resources, our government, or with a lack of opportunity. *The fault lies with our people.* The time has come when those revolutionists who hate our flag and wish to overthrow our institutions, must peel from themselves, or have peeled from them by others, the untruths and hypocrisies in which they are swathed. Blaming institutions and other people does not get the individual anywhere. The path to success lies in industry, self-reliance and obedience to the law.

Obedience to law! We may well think that over, while representatives of the stupid red-handed of Russia and their silly dupes shout:

"Down with the Government."

"Our people live in slavery!"

"Not Lincoln but Lenine."

"Look at those stores. Smash in the doors and take what is your own."

"Buy a gun. Buy a gun."

Such exclamations have been mouthed in our large American cities. This is rot, a disease germ, and it must be killed before it becomes epidemic, else eventually there will be an industrial and social cataclysm in even our richly favored land.

We must get back to our sober senses, to plain living, plain thinking, and away from ostentation and those weakening influences that dehabilitate and destroy.

The evidence is plain.

EXPERIMENTS WITH EXTREMELY HIGH PRESSURES

IN A RECENT bulletin of the West Virginia University Agricultural Experiment Station, Prof. B. H. Hite and associates present the results of work on "The Effect of Pressure on Microorganisms."

No living thing was found that could not be destroyed by pressure. Most bacteria, including those responsible for typhoid, tuberculosis and diptheria, are killed in three minutes by a pressure of 75,000 pounds per square inch. With higher pressures they can be killed more quickly, and vice versa.

Spores require much more severe conditions—higher pressures or much longer time. Spore forming organisms in the vegetation stage are easily killed, and sterilization may be accomplished by repeated brief applications of 75,000 pounds per square inch.

The above applies to room temperatures. Working at somewhat higher temperatures it would be expected that lower pressures would be effective, and this is true, but the explanation may not be as simple as it might at first appear to be, since the same is true of somewhat lower temperatures, the time-pressure death-point curves for 5 degrees C. and 40 degrees C. being practically the same. In sterilizing culture media, etc., it has been customary to work at 40-45 degrees C., to apply a pressure of about 100,000 pounds at the close of the day's work and to find everything sterile and ready for work the next morning.

Working at 4-6 degrees C., a pressure of 75,000 to 100,000 pounds per square inch must be released or any water in the compressed material will be converted into a mass of soft ice. On releasing a pressure of 200,000 pounds at room temperature water is frozen hard. Most other liquids contract on freezing, so freeze at higher temperatures when pressure is applied. Comparatively low pressures were found to be sufficient to freeze many liquids and the use of high pressure in obtaining low temperatures is suggested. Solid chloroform melting at 70 degrees C. was easily prepared.

The high pressure equipment used by Professor Hite and his associates is very simple and easy to construct. A high pressure cylinder may consist of a block of steel with a hole through it, the hole being closed at either end by steel plugs one of which is long enough to serve as a piston. The liquid to be compressed is completely encased in a lead (or other soft metal) packing which consists of a piece of lead tubing both ends of which are closed with lead lids. The pressure is applied to the packing and its contents. There are no leaks. The pressures obtainable are limited only by the strength of the cylinder and piston. Cylin-

ders intended for very high pressures were built up of several concentric cylinders shrunk together and thoroughly stretched by applying higher pressures than were to be regularly used.

FANCIES THAT ARE SNATCHED FROM THE UPPER AIRS

ON A VERY warm day, ROLAND ROHLFS, aviator, flew six miles from Roosevelt Field, Mineola, Long Island, N. Y., into a temperature of twenty-five degrees below zero. He expected this kind of weather, for he wore several pairs of mittens and gloves and a heavy fur overcoat, and his head was completely encased in a fur and leather hood, out of which he peered through inset goggles. It was so cold six miles from New York on this tropical day that the airplane engine was chilled and refused to work.

Sounds like a fairy tale? Not at all, for the explanation of this phenomenon is, of course, that Mr. ROHLFS flew vertically instead of horizontally. From 2.33 p. m. to 5.28 p. m. he flew to a height of 30,700 feet, a height considerably greater than the summit of mighty Mt. Everest, and returned to his starting point. The world's record for altitude is claimed in behalf of Adjutant CASALE, a Frenchman, who was reported in June of this year to have reached a height of 33,136 feet. Mr. ROHLFS thought he could have beaten the CASALE record had he been able to keep his engine warm. One will concede this to have been difficult when sweeping through aerial space at the rate of 100 miles an hour in a temperature of twenty-five degrees minus.

The ROHLFS exploit set one ingenious editorial writer of the New York *Evening Mail* pleasantly speculating on a drowsy drone of a day in City Hall Place. As he put it, most of us do not care for a temperature of twenty-five degrees below zero even in midsummer. But then that temperature was reached six miles in the air above New York. Three miles or even two miles above the softening asphalt and radiating bricks and steel, the temperature is probably no higher than sixty degrees above zero on the hottest day.

Would not a change from ninety, say, to sixty degrees, be sufficient to restore the joy of life to the jaded and overheated city dweller? Why can't we invent gardens hanging between earth and sky, captive balloons with pretty gardens on platforms, with some sort of elevators up and down, and make our weather what we want it? The *Mail* man says the possibilities of finding a place on which to hang such a garden is plainly suggested by the existence and the achievements of the dirigible. Shall we laugh at the thought of a sufferer from hay fever going aloft to freeze the disorder out of his system instead of shutting himself up in a marketman's refrigerator? How many devices and inventions have been considered "impossible" before their actual accomplishment? In any event these were agreeable hot-weather thoughts for which the metropolis owed thanks to Mr. ROHLFS.

While the air experts were examining and checking up the ROHLFS barograph, a farmer out near Kansas City was raising ructions over his property rights to all the air above his farm, which he asserted was his private property and off and away from which he warned all aviator interlopers. He wanted no birdmen swooping down through his private air on to his farm, a'cutting up the wheat and potatoes and melon vines with the landing carriage of such a newfangled contraption. And he stuck a sign on the rail fence warning aviators away!

Now this Kansan declares unequivocally that he owns outright and in fee simple all the land just below his farm right down to the center of the earth and on the other hand that he owns right on up through the air to the top of space —and that no man has a right to fly through his air without his consent. He is going further than merely asserting—he is starting a lawsuit to prevent such use of "his" air.

A Washington writer finds this refreshing, especially to single taxers, for a nice legal point will arise. The earth is moving always one thousand miles an hour; turning around on its axis, it travels more than a billion miles a year in its whirling journey around the sun—and the sun, dragging the earth with it, is furiously rushing through space, heaven knows where, just now toward the blue star Vega.

Consequently the space above that farmer's

land is not the same space now that it was a second ago. It is the same earth, under his acres, but not the same space above them. Does he get the title to all that new space as his farm whirls through infinity?

But let us by all means have these things settled. First thing we know owners of air compressors will be sued for sucking in and bottling up other folks' air without permission!

THE LINE BETWEEN BAROMETER AND TROUT IN POINT

THE BAROMETER is an instrument that is too little known to the layman. Navigators and dealers in weather predictions are familiar with it and use it, as do wholesale commercial fishermen. The modern, progressive surgeon is beginning to heed the barometer and hesitates to perform a capital operation unless he is favored by bright, clear, dry, "high pressure" weather, which increases the chances of his patient for recovery.

The vagaries of atmospheric conditions have a considerable effect upon the human system and effect one's spirits and energy unless he be gifted with an exceptional constitution and exceptional ebulliency of animal spirits and great energy. These conditions are likely to have an effect on fish and fishing, as we shall see.

The barometer, which is properly defined as an instrument for determining the weight or pressure of the atmosphere, and hence for judging the probable changes of weather, and for ascertaining the height of an ascent in an airplane or a balloon, was invented about 1643 by TORRICELLI at Florence. The cup or cistern barometer is made in its simplest form by filling a graduated glass tube about thirty-four inches long with mercury and inverting it in a cup containing mercury. The column of mercury in the tube descends until balanced by the weight of the atmosphere, and its rise and fall under varying conditions is a measure of the change in the atmospheric pressure. At the sea level its ordinary height is about thirty inches, or 760 millimeters.

No self-respecting sea novel of the old-time type, in depicting the peril of the queen's cruiser or the rover, or the gallant square-rigged trader, from impending tempest, failed to preface the Old Man's order to haul in the t'gallants and generally shorten sail, with a reference to an inspection of the falling "glass."

FORTIN'S barometer, used for scientific purposes, is a form of cup barometer having an adjustable cistern. The marine barometer, the mountain barometer, the syphon barometer and wheel barometers, are also mercurial, but the aneroid barometer is based on a different principle. The barometer gauge is a form of manometer especially for measuring low pressures. The marine barometer, it may be noted, for use on shipboard, has its tube contracted at one part to a capillary to prevent rapid oscillations of the mercury, and is suspended in gimbals from an arm or support.

In horology a barometric error is a very small error in the time of a clock caused by changes in the density of the atmosphere. In meterology a barometrical gradient is the rate of fall in atmospheric pressure between two stations; or it indicates the slope of an isobaric surface. In England and America it is usually expressed in hundredths of an inch of mercury for one degree (sometimes one-quarter of a degree) of sixty nautical miles. Thus, a barometric gradient of ten indicates a difference of reading of one-tenth of an inch on the barometer for two places one degree, or one-quarter degree, apart. On the Continent the millimeter is used instead of the hundredth of an inch. Increasing steepness of gradient is accompanied by increasing force of wind; a gradient of six represents a strong breeze; of ten, a stiff gale.

It is furthest from our thoughts to make these definitive observations a treatise on barometrography. Were one not a disciple of the gentle fisherman-philosopher, ISAAK WALTON, the many centuried anniversary of whose birth was celebrated in song and editorial this passing summer, reflections from the barometric glass would possibly not be thus in evidence. But an apparently scientific fisherman, of studious habits and a happy faculty for expression, Mr. JAMES V. INGHAM, has a sporting theory that the trout angler's success is indicated by the barometer, and that this goodly instrument to record air pressure in

time may become a necessary part of every fisherman's outfit. Who are commentators on the business and industrial aspects of air that they could even be tempted to overlook so absorbing a thesis?

Mr. INGHAM offers us in an article in *The New York Sun* a possible if not a plausible solution of a problem which up to the present time remains a *questio vexata* to all trout fishermen. In so doing he gives one a grateful hour of detachment from the chatter of the club car of the Congressional Limited on the cost of high living, what the Brotherhoods will do next and whether the ratification cat will jump to the side of the Versailles pact. We forget the foreign demand for air compressors to bottle up superfluous Boshevik sputterings that clutter the Continental atmosphere, and stop speculating on the size of the air hoist that will be required to lift our personal gold reserve into the Sub-Treasury when we get our clutches on Aladdin's lamp.

Pause is given quite naturally to other daytime fancies when one sees in cold print Mr. INGHAM'S reference to the well known but highly unpopular idiosyncrasy of the varieties of salmonidæ which manifests itself at various times by their obstinate and persistent refusal to take the slightest notice of the most attractive flies, no matter how lightly dropped by the expert caster, though the conditions of weather and water are apparently just the same as those of the day before, when the sport was good. One is maddened to see the beautiful fish at the bottom of the pool, apparently indifferent either to subjective or objective impressions, tempted neither by curiosity, nor influenced by hunger to essay the capture of the strange insects fluttering on the surface of the water above.

Our theorist had bad luck one day. Then he chanced to remember that his aneroid barometer —he seems to belong to the delightful school of one's grandfather who puttered around with thermometers and barometers and weather vanes and sun dials and such—had fallen half an inch on the morning of his arrival at the stream. This brought on an attack of careful consideration of the effects of a diminished air pressure upon the surface of the water. The possible solution of the problem of the coyness of the trout became at once apparent.

One of greater temerity than one who both writes and fishes, and who philosophizes as well, must undertake to spoof the theory of the conclusions reached. It is taken as a fact that all fluids absorb gases under pressure, and just as readily part with them when the pressure is removed, so it must follow that with a diminished air pressure upon the surface of the water that some of the air which the water has absorbed while under a greater pressure or while passing through the rapids of a stream, must leave it.

Now—as the fall of half an inch of the barometer indicates a loss of one-fourth of a pound of pressure on each square inch of surface, some of the air contained in the water must necessarily escape. The deeper water, being still under the greater pressure of the water above it, is less affected by this change of air pressure, and being colder than the surface water, in accordance with another accepted physical fact, further depletes the surface water of its air by absorption.

The recognition of this condition carries with it the realization of the fact that the fish must find greater difficulty in obtaining the necessary blood aeration while swimming in the water near the surface, and consequently they remain at the bottom of pool or stream until the conditions change, making only such incursions into the regions of discomfort as may be required in the quest of food, and only at such times as they will suffer the least discomfort.

There one finds himself as to fish!

Consider the human. An analagous condition affecting man is found in the highest altitudes under a decreasing air pressure, when the difficulties of respiration are increased as the air pressure is diminished, until finally the danger point is reached. In crossing the Continental Divide in the Rockies has one not wagered that he can run the length of the train and back to win a dinner he could not eat because he dropped in his tracks on completing a dogtrot wound up with an hundred-yard dash?

The strain on the heart which follows a marked decrease in the air pressure is so well known that

persons suffering from any organic or functional disturbance of the heart are positively forbidden by their medical advisers to cross the Rocky Mountains, though in the comfortable seat of a Pullman no other exertion than that of breathing is required. The increased rapidity of the respiration calls for more rapid heart action, and that again for more respiration, until at last what is known as a "vicious circle," of which we have heard so much at Washington lately with reference to the H. C. of L., is established, and the weakened and overworked heart gives way.

The fisherman himself will most likely be conscious of the depressing influence of those days when the lighter and moister air seems to deprive him of his energy and diminish his desire to make active exertion.

Mr. INGHAM propounded his theory to fellow-campers and they scoffed at it. He told them there would be no fishing in those parts until his barometer indicated a return to normal atmospheric conditions, and forthwith packed off home. Three or four days afterward the air pressure became normal again, and our fisherman learned with satisfaction that the fishing was as good as it ever had been, both as to the weight and the number of fish taken. He is aware that a single observation is not sufficient firmly to establish such a theory upon, but he hopes that with publicity given the idea that the attention of those most interested will be focussed on the subject, so that further and conclusive proofs may be established.

So the proposition is:

Is a trout fisherman's success or failure in any way dependent upon the amount of air pressure, as indicated by the barometer?

If the INGHAM theory is correct, then a barometer will become a necessary part of every fisherman's outfit. If the answer turns out to be in the negative, something will have been learned, and perhaps from the close study of the conditions which the collection of this barometric data has necessitated, someone will evolve a theory which will stand all the tests and furnish a satisfactory solution of the problem.

COMPRESSED AIR MAGAZINE would totally lack in a sense of appreciation of a fine point that means much in our brief period on this puzzling sphere if it failed to urge that the INGHAM theory be tested by all thoughtful followers of the gentle ISAAK WALTON, so we spoof not while we spin it.

HONOR FOR FATHER OF DAYLIGHT SAVING OF 30 YEARS AGO

AGITATION for and against daylight saving recalls the first introduction of that character of legislation in the Congress three decades ago, when JOSEPH H. O'NEIL, a representative from the fourth congressional district of Boston, introduced his bill providing that the clocks of the nation be turned ahead fifteen minutes on each of the four Sundays in April, until the full hour had been reached. The process was then to be reversed by turning the hands back again fifteen minutes each Sunday in September until sun time had been restored.

This sensible plan to conserve daylight and save the nation millions of dollars at a time when it was not so prosperous as it is today, and also calculated scientifically to add to the American reservoir of health and energy, received scant courtesy or consideration from the other lawmakers of the time and was pigeon-holed. That his idea had merit, however, was demonstrated when European countries adopted it in the course of the Great War and when it finally became enacted into law in this country thirty years after its first introduction, though its repeal unfortunately has followed.

Farmers in some sections have protested against the measure and there have been facetious remarks by rural statesmen that the cows of their districts did not wear wrist watches. Less openly, but none-the-less strongly made, have been the protests voiced by agents for the light and power companies. The public as a whole, however, including manufacturers and other large business interests, have found daylight saving to their advantage, and sentiment, heeded by President WILSON, has been that the fullest enjoyment of "God's medicine," as an old college professor called it, was for the best interests of the largest number of people, in both health and morals, and in an economic sense. Mr. O'NEIL, of Massachusetts, seems fairly entitled to the belated recognition his name is receiving for his salutary plan.

A QUITE EXPECTED DEARTH OF ENGINEERS IN RUSSIA

THE TROUBLE with "Soviet Russia" is "a little knowledge" and too much KARL MARX. B. W. HUEBSCH of New York is publishing and sending forth press agent matter, either wittingly or unwittingly, for the unrecognized Soviet government, including innocent-looking engineering and industrial items. We find ARTHUR RANSOME'S "Russia in 1919," published by HUEBSCH, quoted from on "Turf Fuel for Power" and "Engineering in Russia." PAVLOVITCH, "President of the Committee on Public Works," asks that foreign engineers and technicians come to Russia, "because we are almost as short of skilled men as we are of locomotives—and of course they need not be Socialists, so long as they are good engineers." Possibly if the Bolsheviki had not slaughtered so many of their own countrymen of brains and accomplishments, merely because they did have a degree of intelligence superior to that of the savage brute, there would not now be such a dearth of needed technicians. The terrible fate of reputable men massacred in cold blood, whose only offense against the soviets was that they happened to be cultured, educated gentlemen, and perhaps men of means, will not start any hegira of engineers toward Russia at this time, no matter what propaganda of blandishment through RANSOME and others for the "President of the Supreme Council of Public Economy," continues to be inflicted upon us.

GIANT CUNARD BUILDING TO BE OUR NEXT-DOOR NEIGHBOR

IT IS A PLEASURE for us to note that COMPRESSED AIR MAGAZINE is to have as a next-door neighbor the new 21-story Cunard Building, which will occupy the large and highly valuable site bounded by Broadway, Greenwich and Morris streets and the Bowling Green building. The site is one of the most valuable pieces of real estate in the world and upon it is to be erected a notable structure in which will be housed the general American offices of the Cunard Line, occupying several stories.

Of unusual magnificence and size is to be Great Hall, in which will be quartered the passenger and freight offices of the Cunard. This lofty chamber, one of the largest for commercial purposes in the world, will be 65 feet in height, 185 feet long and 74 feet wide, and will exceed many large auditoriums in size. Mural paintings are projected to tell the story of the development of the steamship company since its early beginnings, and domes, bays and panels will otherwise relieve the lines of the walls of Great Hall.

The architects, BENJAMIN WISTAR MORRIS, and CARRERE & HASTINGS, associates, have provided plans for a structure with an exterior on classic lines with a leaning toward Italian Renaissance. The building will be fully worthy of the traditions of the line it will house and will be a credit to Bowling Green and to the Custom House section near the Battery, with which latter it will be almost within stone's throw, while facing the former historic spot of New York's early Dutch days.

As we write the noted old Stevens House at Morris Street and Broadway is half razed and will soon be a structure of memory only. Next will be heard the sound of the rock air drill, without which no foundation can be built for a Manhattan skyscraper and later will come the staccato of the air riveter on the steel frame, also indispensable in metropolitan building construction. Completion of the Cunard Building will fill out the last remaining available site in lower Broadway below Fulton Street that is not already occupied by a comparatively modern building of earning capacity.

New Berth for W. H. Woody

The Keller Pneumatic Tool Company of Grand Haven, Mich., has opened a division office in the Munsey building, Washington, D. C., to which Mr. W. H. Woody has been assigned as division manager. Mr. Woody was formerly connected with the New York office of the Chicago Pneumatic Tool Co. and later was in that company's southeastern territory. Subsequently he was for a number of years master shipfitter of the hull construction department of the United States Navy Yard at Norfolk, resigning his place there to go with the Keller company recently.

Books and Writers

EFFICIENT RAILWAY OPERATION, by Henry S. Haines, A. S. C. E., A. S. M. E., formerly vice president and general manager of the "Plant System" of railway and steamship lines, Commissioner Southern States Freight Association, one-time President American Railway Association. With tables, charts and statistics. Price, $4 net. New York: The MacMillan Company.

WRITING FROM intimate personal knowledge and experience, our author's working result is an expert book—by an expert. For many years, Colonel Haines was the administrative and operative head of one of the largest railway (and steamship) systems of the country, as well as president of the American Railway Association, so he knows his subject. He traces in his newest work the growth of the railroad from its beginning and especially its development in the United States, clearly defining the principles of efficiency in the department of motive power, rolling stock, roadway, traffic and operation. He has also added a most interesting chapter on what may be called railway strategy in time of war.

The volume contains much up-to-date information of a special character obtained from prominent railway officials and reports of the International Railway Conference. The work is devoted to operation, as distinguished from administration. It deals with facts, not opinions; therefore it does not discuss matters of finance, rates or labor questions. We wish it did discuss the present brotherhood proposals.

In describing the progressive development of efficiency in operation of railways in the United States, as compared with similar progress in other countries, by suggestion of many persons who had inquired for authoritative information for the use of students and junior railway employees, the author has added in appendices, very complete tables of statistics and much strictly technical information, drawn from official sources. The book is a distinctly valuable addition to modern railway literature.

His description of airbrake control of long trains is of value and of high interest and marks the developments in braking efficiency.

PRINCIPLES OF FOREIGN TRADE, by Norbert Savay, M. A., LL.B., sometime special lecturer on foreign trade, Notre Dame University, and formerly counsel of the Russian Consulate General. With appendix and index. Price, cloth, $4 net. New York: The Ronald Press Company.

THE PRIMARY aim of this book, as outlined by its author, is to set forth those general principles which underlie the building up of foreign trade, not merely of such trade as is a convenient outlet for a few superfluous home products, but as a part of a permanent and national foreign trade policy. It is not a "how book" but nevertheless practical details are not entirely omitted.

It is a brand new manual, issued this summer, and covers practically every aspect of foreign trade. It embraces all the technicalities of the subject and blocks out its economic, marketing, legal, shipping, banking, and advertising and selling principles. Dr. Savay tells how to obtain preliminary information on foreign markets, how to conduct investigations on the ground, tells of sources of private and public information both here and abroad, gives suggestions on the training of salesmen for foreign fields, shows how the foreign trader trains his own men, and gives facts on foreign trade customs and policies.

The commercial laws the exporter should know are summarized, as are various methods in use both in America and foreign countries in the financing of shipments. The volume is equally designed for the manufacturer and merchant already engaged in foreign trade and for the business man who seeks a complete knowledge of its possibilities. Here is a timely and competent volume by a man who writes from knowledge and who employs good business logic and practice. The book fills a gap in expert literature and should enjoy a large sale.

ESSENTIALS OF ALTERNATING CURRENTS, by W. H. Timbie, Editor-in-Chief of the War Department Committee on Education and Special Training, Vocational Instruction, and H. H. Higbie, Professor of Electrical Engineering, University of Michigan. First edition, first thousand, viii+374 pages, 5x7. Illustrated with drawings and photographs. Price, cloth, $1.60 net. New York: Messrs. John Wiley & Sons, Inc. London: Messrs. Chapman & Hall, Limited.

THE HOUSE of Wiley has turned out a new book in its technical series under the editorship of Joseph M. Jameson, on the subject of alternating currents, an inexpensive work that will be highly serviceable to the electrical engineering student. Answers to problems in the book are published in separate form in paper binding at a nominal price of 25 cents.

Some of the chapter headings will indicate the value of the work:

Modern Systems of Power Transmission. Transformers. Fundamental Ideas. Impedance. Power and Power Factor. Current and Voltage Relations in Series and in Parallel Circuits. Relation Between Impedance, Resistance and Reactance. Polyphase Circuits. Calculation of Wire Sizes for Various Distributing Systems. Motors, Starters and Controllers. Converters and Rectifiers. Appendix.

Desirable qualities of this book are:

It deals only with the information and problems of alternating-current practice which an electrical worker is most likely to meet in his trade.

It is written in simple language, the method of presentation adopted being such as to enable grammar school graduates to grasp and retain the fundamental information.

It avoids the use of algebra and trigonometry.

It is the result of several years of experience in teaching alternating-current electricity in short intensive trade courses for electric wiremen.

The book is handily indexed and is one that may safely be commended to the student and engineer.

OUR FIRST AIRWAYS, THEIR ORGANIZATION, EQUIPMENT AND FINANCE, by Claude Grahame-White and Harry Harper. With eleven special illustrations by Geoffrey Watson. Price, $1.50 net. London: John Lane. New York: John Lane Company.

IN AN EDITORIAL in the August issue, we called attention to the developments in England in aerial navigation, the establishment of airways and the pioneer work being done by Britishers. Much of what was published in that editorial, entitled, "The Age of Air Begun in both Europe and America," is confirmed in the book by Messrs. Grahame-White and Harper.

Our First Airways is a very business-like and practical little volume that our new American Air Ministry (when we get one) will do well to peruse with care.

Though vague generalizations have already appeared in print—the writers relying mainly on their imaginations—there has been no book as yet, nor indeed, any authoritative piece of writing, which tells a reader in definite terms how this new traffic of the air will be organized and operated for carrying mails and passengers. Mr. Grahame-White, in his capacity of managing director of the Grahame-White Company, has been called upon to review this whole question from the very practical point of view of a contractor to the Post Office (London) for the carriage of mails by air; while Mr. Harper has been acting as technical secretary of the Civil Aerial Transport Committee (London). They are, therefore, fully competent to impart information on this subject.

The book will appeal to the thousands of educated men in air service, many of whom have remained in aeronautics since the war; to practically the whole of the higher-class workers in the large aircraft industry; to the general reading public to whom airway work will open up rapid means of travel.

THE A-B-C OF AVIATION, by Capt. Victor W. Page, Sig. R. C., A. S. Illustrated with drawings, charts and photographs. Price, $2.50 net. New York: The Norman W. Henley Publishing Co.

THIS BOOK has recently come to our attention for the first time and we have found it worthy of careful inspection. It is a complete, practical treatise outlying clearly the elements of aeronautical engineering, with special reference to simplified explanations of the theory of flight, aerodynamics and basic principles underlying the action of balloons and airplanes of all types, and at the same time is a non-technical manual for all students of aircraft.

The author indicates that the work is not intended to be an engineering treatise, nor is it intended to consider technical points that can interest only the designer. Every effort has been made to explain all difficult points and numerous diagrams have been prepared to amplify the text. The book is well adapted for instruction work on general principles of mechanical flight and their practical application in both lighter-than-air craft and airplanes. It will be found, too, as well suited to home study work as to classroom instruction.

Compressed Air at Carnegie Tech.

To the Editors of COMPRESSED AIR MAGAZINE:—With reference to your recent publications on the subject of education in compressed air practice and your letter to President Hamerschlag of the Carnegie Institute, which was referred to me for reply, permit me to state:

The subject of pneumatic engineering is a very important one, but it is not broad enough to form the basis for a separate department in a technical school. And as long as it is scattered through mechanical engineering, mining and metallurgy, it does not receive the attention which it deserves. Recognizing this condition, I put into the course of mechanical engineering at Carnegie Tech, a course on pumps and compressors, which is studied by mechanical, mining and metallurgical students.

The Carnegie Institute is always willing to add options and courses, if there is a real demand for instruction. If we had any assurance that there would be ten to twelve students each year to follow the subject of pneumatic engineering, we would most certainly provide an option in that line of work. Manufacturers of pneumatic equipment could assist materially in furnishing the laboratory with pneumatic machinery and could furnish data and drawings for the use of students. But who is going to furnish assurance that there will be regularly that number of students?

In the department of mining engineering, the mine owners of Western Pennsylvania and of West Virginia have united to assure a regular supply of students for a special course in coal mining, which proves that a regular supply of students can be guaranteed, if somebody will take interest in the work.

If you are interested, I can give you a synopsis of our course in pumps and compressors.

W. TRINKS, *Professor.*

Carnegie Institute of Technology, Pittsburgh, Pa.

Buenos Aires

To George V. Hobart

At ten, a child, at twenty, wild;
At thirty, tame, if ever;
At forty, wise; at fifty, rich;
At sixty, good, or never!

Experience.

Mr. A. Flam is a dealer in skins in the late twenties, Manhattan, it would probably charm Franklin P. Adams of the *Tribune* "Conning Tower" to learn. We haven't encountered Mr. Flim anywhere on our travels; that is, not by name.

We wonder where some of our modern American slang originated. Ever hear of a poetical gentleman named Pope? It was he that penned the lines:

You beat your pate, and fancy wit will come—
Knock as you please, there's *nobody at home.*

In a not too distant future, may we hope and pray,
They will furbish all the kiosks of the old Subway.

Two lawyers, when their wrangled case was o'er
Shook hands, and were just as good friends as before.
"Say!" yelled the losing client, "how come you
To be such friends who were such foes just now?"
"Stupid!" one answered, "lawyers, though so keen,
Like shears, ne'er cut themselves, but what's between!"

The Client.

MAIN STREET JOTTINGS

GOTHAM, Sept. 1.—The Penn hotel up near the depot had some strangers for supper last Friday night. Some caitiff from Westchester county, or some other place out West, got away with the comb and brush from the washroom, it is rumored, and there is talk of putting chains on the new ones. The idea is to hook up the chains with the electric lights so that if anybody cuts them that there will be a short circuit leaving the miscreant in the dark and making it easy to capture him. The new equipment will probably be bought at Jim Bell's store next door to the hotel.

Town Constable Enright has been busy of late with his deputies in ferreting out crimes and the like in these environs. One Rolls-Royce and a couple of Henry-Fords were taken right from in front of the Hickory Street garage the other evening while Slim Smilax and Hi Jenkins were to home getting supper. The very next day a motorcycle was stolen from in front of the Ee-light movie house. The worst of this was that the motorcycle belonged to our traffic department, which is Jack Cowslip, who was inside the movie getting pointers from Bill S. Hart. These here auto thieves have got to stop their dastardly depredations, is what our constable says, else he will have the law down on their heads or know the reason why.

News are pretty scarce at this writing, although ye cor. has tried graphic automatism like Jack Chaloner used, to bring the ideas seething forth, but all in vain. Maybe our Horn & Hardart automatism, which causes a callus on the right thumb, hinders our writing much. Jack, who has been on a visit here from Virginia, now that he can legally transact business in this vicinage, used to sit down with a pencil in his hand, according to Doc Wood, and the hand would write without his thinking of a thing in particular. We'll bet that's the way that reptile editor of the scorpion *Sentinel* gets a lot of his alleged news.

Vox Populi.

A friend of ours is going on his belated vacation and gosh, how he dreads it. His holiday is to be taken in these here now *sec* states.

If this plinth of perspicacity looks a bit lean this month it's because the contributors have been off fishin'.

BAWMIE INTHEBEAN.

FOURTEEN POINTS IN THE LEAGUE OF SUCCESS

*By BERT EDWARD BARNES**

MANHOOD which stands for strength in purpose and virility in action.

OPTIMISM, that which gives courage, sweetens toil and lightens the burdens.

RESOURCEFULNESS which conquers obstacles and attracts other men to you.

ENERGY, the powder of success which produces the miracles of enthusiasm.

ENTHUSIASM, the salt of life that renews and enriches everything it touches.

FRIENDSHIP, a beautiful and noble thing, which animates virtue and good resolutions.

FIDELITY which puts more than an expectation of pay into one's work.

INTEGRITY, an indispensable virtue, the cornerstone of most successes.

CHARACTER, one of life's most precious things, cherished by all.

INITIATIVE, the essence of character and the basis of most big achievements.

ENDURANCE, a better test of character than any one act of heroism, however noble.

NOBILITY, that which carries sunshine and good cheer to the poor and suffering.

CHEERFULNESS, a public duty, irrelevant to any religious creed or doctrine.

YOUTHFULNESS of spirit which has its fruitage in the preservation of health.

*Editor *Morse Dry Dock Dial.*

CONFIDENTIAL EMPLOYMENT BUREAU

NOTE—Advertisements under either of the classifications below will be numbered in the order of receipt and published free of charge, for the benefit of readers, in the next issue after date. All applications for the use of this convenience should be directed, "Confidential Employment Bureau," Compressed Air Magazine, Bowling Green Building, New York City. Replies to advertisements will be forwarded to the person or persons concerned.

HELP WANTED.

No. 429—Coal Mining Engineer of experience with a prominent company. Exceptional opportunity for man of ability who is willing to work and makes good. Give references, state previous experience, salary, etc. Confidential.

No. 430—Wanted a Coal Mine Foreman for large electrically equipped mine. Location, Pennsylvania. Married man preferred. Give full information as to salary, references, etc.

No. 431—Wanted by manufacturer of machine tools, an assistant superintendent of shop. Must possess thorough knowledge of modern foundry and shop practice. Give full information. Position and location will appeal to an A-1 man.

No. 432—Draftsman wanted, experienced in die, jig and fixture designing for work in automobile manufacturing plant, located in Ohio. Good future, pleasant location. Describe self and experience fully. State salary.

POSITIONS WANTED.

No. 854—Production Manager, with 10 years shop and foundry experience, capable of taking entire charge of plant, desires to make connection with a growing business in the middle west. At present employed. Best of references as to character and qualifications.

No. 855—Metallurgical Engineer of experience will be open for position on October 1st. At present employed on temporary work. Thoroughly experienced in test treatment of metals and competent to take complete charge of chemical, physical and metallographic laboratory. Interested only in first class position.

No. 856—Graduate Civil Engineer, four years general experience on roads and concrete and steel structures, drawing room and field, wants position with a company in the west. Must be opportunity for advancement. Married and can give best of references.

No. 857—Position wanted by Mining Engineer as general mine superintendent. Age 39, married. Have had 10 years practical experience, 5 of which were with large gold mining company in the west. Seeking change for greater opportunity.

No. 858—Married man of 36, of good habits and record seeks change of position. Experienced in installing and operating gas engines, electrical machinery and compressors. Has also had machine shop experience, mechanical drafting and office work. Understands concrete forms and foundation work and can handle men and materials with good results.

No. 859—Young Scotch mining engineer writes from Scotland expressing his desire to obtain a position in the U. S. A. with either a coal or a metal mining company. Has had thorough schooling, is well up in the use of transit and can supply excellent references.

No. 860—Underground operating engineer, acting as mine superintendent, having sixteen years' experience in mining and familiar with construction work, seeks a place in Arizona or Far West. American born. Thoroughly familiar mining machinery and methods. Ample references. Salary $200 monthly to start.

WESTINGHOUSE HOUSING PLANS

Housing facilities which at present are inadequate at Wilmerding, Pennsylvania, the home of the Westinghouse Air Brake Company's Works are to be extended at once by the erection of a number of new dwellings for the families of the employees.

The Westinghouse Air Brake Home Building Company has been formed with a capital of $1,000,000 for the purpose of transacting all business relative to the real estate and dwellings which have been transferred by deed to this company by the Westinghouse Air Brake Company. It includes the ownership of over 400 houses and considerable vacant property in the borough of Wilmerding and the adjacent territory.

Since the Westinghouse Air Brake Company built its first houses for employees in 1890 there has never been an increase in rents and the new company will carry out the same policy.

A director of the Marconi Co. states that experiments on a new type of wireless telephone are so far advanced that it will shortly be possible to speak between London and New York, while the establishment of a regular commercial service by wireless telephone between London and New York early next year is expected.

Latest U. S. Patents

Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

JULY 8.

1,308,811. PERCUSSION-DRILL. Lewis L. Scott, St. Louis, Mo.

1,308,848. VACUUM FUEL-FEED DEVICE. Webb Jay, Chicago, Ill.

1,308,850. MOUNTING FOR FLUID-PRESSURE SYSTEMS. Everett P. Larsh, Dayton, Ohio.

1,308,904. METHOD OF AERATING LIQUESCENT MATERIAL AND MACHINE FOR THE PURPOSE. Mark Hopkins and Charles Brunkhurst, Middletown, N. Y.

1,308,929. METHOD OF AND APPARATUS FOR SULFUR-MINING. Robert E. Carmichael, Damon, Tex.

1,308,930. HUMIDITY AND TEMPERATURE REGULATOR AND THE LIKE. Willis H. Carrier, Buffalo, N. Y.

1,308,961. DUST-COLLECTOR. Jeffrey J. Power, Madison, Wis.

1,308,982. FAN-BLOWER. Frans H. C. Coppus, Worcester, Mass.

1,309,166. GLASS-BLOWER. Edward O. Whitley and Edward L. Knowlton, Williamstown, W. Va.

1,309,193. RODENT-EXTERMINATOR. Jacob T. Garrison, Oakland, Calif.

PATENT NO. 1,309,19[illegible]

A rodent exterminator comprising a combustion chamber including a metal outer wall, a sheet asbestos inner wall and a filling of insulating material therebetween, a fire pot within the chamber, a reservoir exterior to the chamber and having a valve controlled pipe leading to the fire pot, means for supplying air under pressure to the reservoir, a flexible pipe connected with the combustion chamber and a nozzle at the free end of the flexible pipe.

1,309,229. PUMPING SYSTEM. Frederick C. Weber, New York, N. Y.

1,309,282. MULTISTAGE CENTRIFUGAL FAN AND PUMP. William Johnston Frame, London, England.

1,309,321. AIR-GUN. Frederick Humbert Fairweather, Bridgeport, Conn.

1,309,457. MILKING-MACHINE. John S. Buckwalter, Lancaster, Pa.

1,309,465. METHOD OF BLOWING DOWN AND BLOWING OUT BLAST-FURNACES. John W. Dougherty, Beaver, Pa.

1. The method of blowing down and blowing out blast furnaces, comprising forming and maintaining within the furnace a non-explosive gaseous mixture at about when the blast is turned off.

1,309,517. TIRE-PRESSURE INDICATOR. Benjamin G. Gilbough, Los Angeles, Calif.

1,309,528. AIR-PUMP. George Klundt, Streeter, N. D.

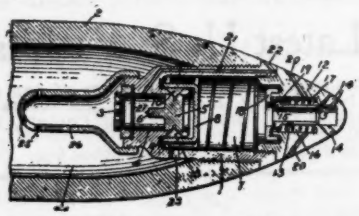
JULY 15.

1,309,649. PERCUSSIVE ENGINE. Wilhelm Mauss, Johannesburg, Transvaal, South Africa.

1,309,718. VACUUM-FEED FOR OIL-ENGINES. George C. Clark, Everett, Wash.

1,309,737. AIR WASHER AND HUMIDIFIER. Robert A. Ilg, Chicago, Ill.

1,309,773. PNEUMATICALLY - OPERATED IMPACT-FUSE. Edward W. Newell, Pittsburgh, Pa.



PATENT NO. 1,309,773.

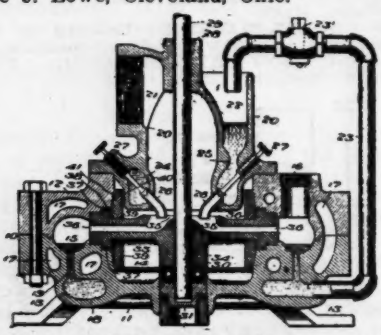
1. A projectile provided with a chamber and having inlet ports through which air from the atmosphere is compressed into said chamber by the flight of the projectile, a firing plunger for detonating the projectile, and means operated upon impact of the projectile for supplying fluid from said chamber to operate the firing plunger.

1,309,786-7-8. FLUID-PRESSURE BRAKE. Walter V. Turner, Wilkinsburg, Pa.

1,309,825. AIR-CUSHION FOR STEAM-NIGGERS. William Henry Trout, Milwaukee, Wis.

1,309,879. VACUUM AIR-SEPARATOR. Ernest M. Davids, Tropico, and Lycurgus Lindsay, Los Angeles, Calif.

1,309,880. AIR-CHARGING DEVICE. Frank C. Dorment, Detroit, Mich., assignor of one-half to George J. Lowe, Cleveland, Ohio.



PATENT NO. 1,310,116.

1,309,923. PNEUMATIC SCRAPER FOR CLEANING FISH. Edward H. Waugh, Seattle, Wash.

1,309,942. GLASS-DRAWING APPARATUS. Halbert K. Hitchcock, Pittsburgh, Pa.

1,309,943. APPARATUS FOR PUMPING FLUID. Herbert Alfred Humphrey, London, and William Joseph Rusdell, Wolverhampton, England.

1,309,977. AIR-HEATING APPARATUS. Henry Baetz, St. Louis, Mo.

1,310,099-101. BLOWPIPE. George L. Walker, New York, N. Y.

1,310,116. CENTRIFUGAL PUMP FOR COMPRESSION AND VACUUM. Edward C. D'Yarmett, Muskogee, Okla.

1,310,152. LIQUID-FUEL FURNACE. William M. Burdon and Matthew M. Burdon, Bellshill, Scotland.

1. A method of burning heavy oils for heating purposes in which air is heated to a temperature above the flash point of the oil and is then caused to gyrate and while in a state of gyration is caused to atomize and vaporize oil delivered to the interior of a hollow member through which and also outside of which the gyrating air passes, whereby the oil in a finely divided state will be disposed between an inner and outer stream of air.

1,310,393. VACUUM FEED MECHANISM. Floyd Garwick, Chicago, Ill.

1,310,332. TIRE-PUMP FOR AUTOMOBILES. Joseph Marie Etienne Franc, St. Vallier, France.

JULY 22.

1,310,455. METHOD OF ROASTING ORES OR CONCENTRATES. Urlyn C. Tainton, Doornfontein, Johannesburg, Transvaal, South Africa.

1,310,471. AIR-COMPRESSOR. John C. Fredericksen, Miller, Ind.

1,310,672. COOLING AND INSULATING SYSTEM FOR TURBO-COMPRESSORS. Earl H. Sherbondy, Cleveland, Ohio.

1,310,682. DUPLEX TURBO-COMPRESSOR. Earl H. Sherbondy, Cleveland, Ohio.

1,310,745. AIR-GUN. Albin R. Falk, Moline, Ill.

1,310,815. DUSTING-MACHINE. Bent L. Weaver, Harrisburg, Pa.

1,310,876. AIR-PUMP. Paris L. Savage and Herbert E. Morton, Bisbee, Ariz.

1,310,944. AIR-COMPRESSOR. George K. Davol, San Francisco, Calif.

1,311,023. AUTOMATIC AIR-HOSE COUPLING. Wallace H. Stone, Wabasha, Minn.

JULY 29.

1,311,161. BLACKING-MACHINE. Frederick M. Furber, Revere, Mass.

1,311,235. METHOD OF AND APPARATUS FOR PRODUCING BLASTS OF HEATED AIR. William Wallace Kemp and William H. Van Horn, Baltimore, Md.

1,311,249. METHOD OF AND APPARATUS FOR GATHERING GLASS BY SUCTION. Emile Roirant, St. Ouen, France.

1,311,328. AUTOMATIC VALVE FOR CONTROLLING THE FLOW OF GASEOUS MIXTURES. Henry S. Dodd, Toronto, Ontario, Canada.

1,311,358. PNEUMATIC SEPARATOR. Harold M. Plaisted, St. Louis, Mo.

1,311,533. COMPENSATING PUMP FOR PNEUMATIC VEHICLE-TIRES. Harry C. Schroeder, Berkeley, Calif.

1,311,594. PROCESS OF AND APPARATUS FOR OBTAINING OXIDS OF NITROGEN FROM ATMOSPHERIC AIR. Francis I. DuPont, Wilmington, Del.

1,311,617. PNEUMATIC-DESPATCH-TUBE APPARATUS. Albert W. Pearsall, Lowell, Mass.

1,311,647. CARRIER-DESPATCH APPARATUS. Charles P. Hidden, Brookline, Mass.

1,311,693. AUTOMOBILE-TIRE PUMP. George Edgar Hazard, Rochester, N. Y.

1,311,738. METHOD OF MAKING PUNCTURE-PROOF TIRE-TUBES. George F. Armstrong, Rutherford, N. J.

1,311,760. MEANS FOR AND METHOD OF APPLYING COATING. Harry O. Davis, Ipswich, Mass.

1,311,806. SECTIONAL PNEUMATIC TIRE. Henry B. Coats, Veedersburg, Ind.

1,311,815. BLOWPIPE-BURNER. John Harris, Cleveland, Ohio.

1,311,839. PNEUMATIC COATING APPARATUS. Jens A. Paasche, Chicago, Ill.